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T	:	Transvaal	Transvaal
V	:	Free State	Vrystaat
W	:	Winter Rainfall	Winterreën

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FINAL REPORTS ON RESEARCH PROJECTS
FINALE VERSLAE OOR NAVORSINGSPROJEKTE

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PLANT PRODUCTION PROMOTION

AGRONOMY RESEARCH

Summer grain

MAIZE

• Pathology

GG.2111/19/4/2: IDENTIFICATION AND PATHOGENICITY TESTING OF ORGANISMS WHICH ARE ISOLATED FROM MAIZE ROOTS AND STEMS. 1980-1985
K.R. Chambers

One-hundred-and-fifteen fungi isolated from roots of both maize and sorghum and from maize seed were tested for their ability to infect the roots and reduce seedling emergence of two maize cultivars. Isolates differed significantly with respect to their ability to enter maize roots.

Only one isolate, a *Pennicillium* sp., significantly reduced seedling emergence. Isolate source had no effect on pathogenicity or seedling emergence.

• Pests

GG.2111/20/2/3: ECOLOGY OF THE MAIZE STALK BORER. 1959-1987
G.D.J. van Rensburg

The seasonal abundance of *Busseola fusca* moths at five localities in the maize production area of South Africa was monitored by means of Robinson light traps. Geographical variation in the flight pattern was shown to exist between localities from east to west. Both the time and magnitude of the three seasonal moth flights seem to be governed by climatic factors.

The extent to which seasonal fluctuations in the number of *Busseola fusca* moths can be explained by precipitation data was demonstrated. Daily flight activity is enhanced by cool, humid conditions and restricted by rain. Humidity was shown experimentally to be of importance in the survival of moths under laboratory conditions. It is suspected that the observed relationship between seasonal moth numbers and rainfall is an indirect one and that survival of moths is rather determined by the direct influence of humidity. More serious infestations can therefore be expected during years with favourable rains occurring at strategic times.

New information on the intra-seasonal progression of larval infestations was obtained through repeated sampling in maize plantings of different planting dates over various seasons. Owing to the occurrence of distinct periods of moth flight, variation in planting date had a marked influence on levels of larval infestation. Plants were most attractive as sites for oviposition between three and five weeks after emergence, resulting in a definite pattern in the time distribution of different larval instars in different plant parts. In the pre-tassel stage of plant development, most larvae occurred in localised groups within the whorls, reaching maximum numbers eight weeks after plant emergence.

The emergence of the tassel forced some larvae to migrate to adjacent plants, resulting in an increase of internally damaged plants without an increase in larval numbers. Scouting for eggs over a limited period of plant development can lead to better timing of spray application and thus to more cost-effective control measures.

Damage by larvae to plant parts other than the whorl had an important influence on yield. Damage to plants in the period after tasseling was particularly important. The number of larvae in the plant was a weak estimator of expected yield losses, since the degree of infestation was not linearly correlated with the degree of internal injury to plants.

Fourteen maize fields, representative of the conditions prevailing in the main maize producing areas, were monitored during the 1984/85 growing season. Three maize fields were also monitored during the 1985/86 and 1986/87 growing seasons.

The number of plant-parasitic nematode species present in the fields was very low but several potential pathogenic species were found. The predominant ectoparasites were *Paratrichodorus minor*, *Scutellonema brachyurum* and *Criconelemello sphaerocephalo*.

In the soil, the mean numbers of plant-parasitic nematodes were low three weeks after planting but increased, on average, five-fold about eleven weeks after planting.

Although all three fields showed a build-up of the total plant-parasitic nematode population towards harvest of the 1985/86 season, nematode populations were very low again at the beginning of the 1986/87 season.

Fourteen maize fields, representative of the conditions prevailing in the main maize-producing areas, were monitored during the 1984/85 growing season. Three maize fields were also monitored during the 1985/86 and 1986/87 growing seasons.

The number of plant-parasitic nematode species present in the fields was very low but several potential pathogenic species were found. The predominant endoparasites were: *Pratylenchus zeae* and *Pratylenchus brachyurus*.

In the roots, the mean numbers of plant-parasitic nematodes were highest three weeks after planting and decreased, on average, by almost 50 % about eleven weeks after planting.

Although all three fields showed a build-up of the total plant-parasitic nematode population towards harvest of the 1985/86 season, nematode populations were very low again at the beginning of the 1986/87 season.

• Crop science

The use of leaf diffusive resistance (LDR) response, as a measure of atrazine and cyanazine toxicity in maize, was investigated under controlled conditions. Higher concentrations of either herbicide caused greater LDR responses. Inbreds, displaying differential tolerance to cyanazine, could be identified within four days of herbicide application, using the LDR technique. Plant reactions to these herbicides were shown to be reflected by changes in LDR. In this way, recovery from effects of the herbicide could be measured. In experiments designed to find an explanation for increased LDR with photosynthesis-inhibiting herbicides, a technique utilising isolated epidermi was developed. Using this technique, it could be shown that cyanazine had no effect on stomatal movement *per se* but influenced stomatal aperture and hence LDR by the inhibition of photosynthesis in leaf tissue.

Inheritance patterns of atrazine tolerance in South African maize were investigated. A total of 78 inbred lines from Potchefstroom and Cedara were screened for atrazine tolerance under controlled conditions. The gradual gradation of leaf mass response to atrazine suggested polygenic inheritance. Evidence provided by three diallels strongly indicated a preponderance of additive gene effects. Some significant heterosis and the existence of cytoplasmic inheritance was also indicated. The possibility for greatly increasing inheritance was also indicated. Inheritance patterns of veinal chlorosis response to atrazine were not clear.

Sixty-seven commercial maize cultivars were screened for atrazine tolerance using a nutrient solution technique in a glasshouse. Differential tolerance to atrazine existed with no cultivars displaying exceptionally low tolerance. Cultivar tolerance could not be related to certain seed or seedling characteristics. The tolerance rankings of ten cultivars differed when evaluated in the field, or under controlled conditions where plant nutrition and temperature were varied. These cultivars were also shown to differ in their ability to recover from initial atrazine phytotoxicity. Veinal chlorosis, based on visual ratings were found to be poor indicators of atrazine phytotoxicity.

- *Water requirements*

GG.2111/31/2/4:

THE MEASUREMENT OF AVAILABLE SOIL WATER, ROOT DEVELOPMENT, GROWTH AND PRODUCTION OF MAIZE ON HUTTON/BAINSVLEI SOILS. 1985-1988

R. Mottram

Although reliable techniques have been developed for monitoring plant water stress, the need for establishing suitable stress-yield relationships remains. Furthermore, such relationships should be determined for different varieties of a given crop. Five varieties of maize were planted in a line source sprinkler plot irrigation system. This system produced a water application pattern uniform down the length of the plot and continuously, but uniformly variable across the plot.

Infra-red foliage temperatures were used to determine three different types of plant water stress index. Three indices provided a measure of severity of stress. Not only were significant yield differences found as a result of different amounts of irrigation, but between hybrids at the same level of irrigation.

Small grain

WHEAT

- *Upgrading*

GG.2121/07/1/2:

GRAIN YIELD AND PROTEIN CONTENT IN F6 LINES OF *TRITICUM AESTIVUM* OBTAINED BY SINGLE SEED DESCENT. 1976-1987

H.A. Cerfonteyn

Single seed descent was used to generate 158 F6 lines from the cross Betta x Scheepers 69. These, with their parents, were entered together into two adjoining trials, each trial being subjected to a different rate of nitrogen application, namely, 15 and 45 kg/ha, for the evaluation of grain yield and protein content.

Uncontrollable infestation by the Russian aphid, *Diuraphis noxia*, was observed at the low nitrogen rate. This increased the coefficient of genetic variation (CV_G) for yield but not for protein. CV_G for yield at N = 15 kg/ha (L) was 27 % while at N = 45 kg/ha (H) was 15 %. CV_G for protein was in the region of 4 % at both rates of nitrogen application.

The genetic and environmental correlations between yield and protein were negative for the offspring. Averaged over the two rates of nitrogen application, $r_G = -0.65$ (which could be due to pleiotropic and/or linkage) and $r_E = -0.17$ (which could be due to physiological and/or agronomic factors). The phenotypic relationship between yield and protein is apparently also negative in the case of the parents.

Genotype-environment interaction between nitrogen rates was more evident for yield ($r_G = 0.64$) than for protein ($r_G = 1.0$) in the case of the offspring. Although this could be due in part to the aphid infestation, these results are similar to those obtained by Stander and Louw (1978).

Prediction of direct response to selection showed that either yield or protein can be increased to exceed that of the best performing parent, although a decrease in the negatively correlated traits is unavoidable. However, some response is possible in both traits simultaneously by selection on a suitable index combining these two measurements.

- *Pathology*

GG.2121/19/1/2:

IDENTITY AND PATHOGENICITY OF *RHIZOCTONIA* SPP. ASSOCIATED WITH CRATER DISEASE OF WHEAT. 1980-1986

D.B. Scott

A new endemic form of *Rhizoctonia solani* proved to be the cause of crater disease of wheat on the Springbok Flats in the Northern Transvaal. Crater isolates of this fungus anastomosed with one another, but not with any one of the tester strains representing previously described anastomosing groups of *R. solani*. The fungus produced pronounced bead-like swellings on the roots of affected plants.

Similar root symptoms were obtained by growing wheat in a glasshouse in undisturbed blocks of soil from craters, but not in loose soil from inside craters nor in soil from immediately outside craters. The disease was also induced artificially in the field by inoculating soil outside a crater with pure cultures of the new form of *R. solani*.

From the results obtained in this study, it is clear that if the cause of root impedance in the heavy clay soil on the Springbok Flats can be eliminated, crater disease should also be eliminated or minimised. The large clods of clay on the Springbok Flats have a bulk density which falls within the highly impeditive range for roots. In sandy soils high bulk densities can be reduced by deep cultivation, but in clay soils this method is not practical or economical.

The best way to ensure better root development in clay soils is to plant the crop in soil watered to field capacity. This can be done by improving water infiltration of the soil through cultural methods such as "basin" tillage. Suitable implements are now being manufactured and probably would soon be generally available for use on the Springbok Flats.

GG.2121/19/1/4:

TO OCCURRENCE OF *PYTHIUM* SPP. IN SOIL AND THEIR IMPORTANCE IN ROOTROT OF WHEAT. 1983-1988

D.B. Scott

Studies were initiated in 1983 to isolate species of *Pythium* from wheat-field soil and to determine their pathogenicity to cereals under different environmental conditions. *P. irregulare* and *P. ultimum* were isolated most commonly from soil, while *P. aphanidermatum* was isolated only from two soil samples. All three species caused pre-emergence damping-off in a variety of crops. Post-emergence damping-off in cereals occurred mostly as a result of the parasitic activities of *P. arrhenomanes*, a fungus not previously recorded in South Africa.

Susceptibility of grain crops to damping-off was greatly affected by temperature. *P. ultimum* and *P. irregulare* were most virulent on wheat, rye and oats at 15 °C and less so at higher temperatures. *P. aphanidermatum* and *P. arrhenomanes* affected seedlings of wheat, rye and oats only at temperatures above 20 °C. Cereals like sorghum and millet, on the other hand, were affected most severely at temperatures below 20 °C.

From the results obtained in this study it is concluded that damping-off in cereals can best be controlled by avoiding poorly drained soils and by delaying planting date for both winter- and summer-grown crops so that germination of seeds will take place as close as possible to the optimum growth temperature for that particular kind of crop. The disease can also be controlled by the use of specific fungicides as seed dressings. Metalaxyl is very effective, but this fungicide has not yet been registered in South Africa on cereal crops.

Protein and oil seeds

GROUNDNUTS

• Physiology

GG.2131/03/3/1:

DRYING CHARACTERISTICS OF GROUNDNUTS. 1983-1987

C.J. Swanevelder

When groundnuts are harvested and packed in stacks to mature, moisture is lost at a certain rate. To determine this, a trial was conducted at Vaalharts Research Station. The different treatments applied were:

- dig and stack on the same day;
- dig and stack after one, two and three days, respectively;
- dig, leave in soil and stack after one, two and three days, respectively.

Stacks were packed 130 cm high and 100 cm in diameter. Climatic conditions were monitored during the trial period.

At harvest after 150 days, the moisture content of seeds was 41 % and that of the vines up to 76 %. After one week in the stack the moisture content of the seeds dropped to 21 %. The top third of the stack lost moisture up to this stage at 21 % per week compared to 6 % of the bottom third.

During the second week the top third dried out below the required moisture content of 10 % for picking while the middle and bottom thirds were still too wet.

When the plants were dug and left on the soil, moisture loss was faster compared to when it was dug and stacked immediately.

Moisture content of the shells dropped sharply, from 65,9 % to 43,6 % when left in the sun for one day while there was practically no change with the seed moisture content (from 41,3 % to 40,9 %). After two days

in the sun the moisture content dropped with 7 and 14 % for the seeds and shells, respectively. The moisture content of the vines dropped from 76,2 to 35,1 % after three days in the sun.

When the groundnuts were dug and left in the soil, moisture loss was much slower. The vines lost 11 % in three days, the shells 10 % and the seeds 3 %.

The moisture content in the different parts of the stack vary considerably and this fact needed much consideration at picking time because losses may occur if picking is delayed, or being commenced too early.

• Pathology

GG.2131/19/3/12:

PATHOGENICITY STUDIES WITH *CHALARA ELEGANS* OF GROUNDNUTS. 1982-1985

C.L.E. Labuschagne

The taxonomy of the genus *Chalara* (Corda) Rabenh. is discussed and it is concluded that the deposition of *Thielaviopsis basicola* (Berk. & Br.) Ferraris under the new name *Chalara elegans* by Nag Raj & Kendrick, is justified.

In recent years *C. elegans* has become a serious problem in various groundnut production areas in the Republic of South Africa. The cultural and pathogenic behaviour of *C. elegans* were determined in laboratory and greenhouse studies to identify different races of the pathogen. This was done to assess their importance in screening of breeding material for disease resistance. Thirteen isolates of *C. elegans* from different geographical areas in South Africa were obtained from infected groundnut, tobacco and citrus plants. The isolates could be differentiated according to *in vitro* growth characteristics. Groundnut isolates did not differ significantly on two different media, regarding temperature, pH and osmotic potential effects, but differed significantly from the tobacco and citrus isolates. Only the citrus isolate was capable of growth at 30 °C and one tobacco isolate grew optimal at pH 6.

All other isolates (including the citrus isolate) grew optimally at 25 °C and between pH 7 and 8. Soil was artificially infested with inoculum consisting of 150 propagules/g sand. The isolates were found to differ significantly in the *in vivo* studies. The groundnut isolates with similar pathogenic features differed significantly from the tobacco and citrus isolates which has distinct pathogenic features.

Four different races of *C. elegans* were distinguished according to the pathogenic and cultural behaviour of the various isolates, viz. race I - olivaceous cultures, pathogenic to groundnuts, cotton and beans, represented by the groundnut isolates from Potchefstroom, Loskop, Delareyville, Vaalharts, Douglas and Fauresmith; race II - olivaceous cultures, pathogenic to cotton and beans, represented by the citrus isolate from Rustenburg; race III - gray cultures, intermediate pathogenic to cotton, represented by the tobacco isolate from Brits and race IV - olivaceous cultures, non-pathogenic to groundnuts, cotton or beans, represented by the tobacco isolate from Potgietersrus.

SUNFLOWERS

• Physiology

GG.2132/03/1/1:

STUDY ON THE EFFECT OF ENVIRONMENTAL FACTORS IN GROWTH, DEVELOPMENT AND YIELD OF SUNFLOWER. 1982-1984

R.N. de Vos

This research was conducted in the first place to determine the effects of temperature, soil water and photoperiod on the growth, development and yield of sunflowers; and secondly, to determine whether field experiments using a number of planting dates can provide adequate variation in environmental conditions to simulate a range of environments.

For this purpose, a field trial involving four planting dates and three sunflower cultivars was planted at Potchefstroom, a site fairly representative of the South African summer grain crops region.

The photoperiod at planting exerted some effect on the rate of development of one of the cultivars in the early stage of vegetative development. Numerical values were obtained from the field data for the coefficients of published developmental models which take photoperiod and temperature into account.

Indications that the mean air temperature during the early vegetative development of the plant affects crop growth rate were found, although clear evidence could not be obtained owing to the small range of temperatures encountered.

The results from the experiment indicated that soil water stress during flowering plays a dominant role in determining final seed yield, and that a simple stress index can provide a numerical assessment of the

amount of stress. Furthermore, this stress index was found to be correlated with yield, forming the basis for possible future sunflower yield models.

The mechanism through which the reduction in yield is brought about appears to be the reduction in post-anthesis leaf area duration, which was also correlated with the stress index.

Post-anthesis mean air temperature was shown to affect the seed oil quality, with increases in temperature causing a reduction in the linoleic acid, and a corresponding increase in the oleic acid content of the seed oil. Evidence that soil water stress also affects the seed oil quality was found.

The results from the field trial also indicated that planting date trials can be useful in providing a range of environments for evaluating the effects of environmental factors on sunflower growth, development and yield, but that the range of temperatures and photoperiods encountered are normally not large enough to develop predictive functions. To increase the usefulness of such trials, a wider range of environments need to be sampled, and these trials must be conducted in conjunction with extensive phytotron work. Planting date trials can, however, play an important role in the evaluation of existing models.

• Pests

GG.2132/20/1/1:

THE IDENTIFICATION OF THE NEMATODES ASSOCIATED WITH SUNFLOWER.
1984-1989

C. Bolton

Fourteen sunflower fields, representative of the conditions prevailing in the main sunflower producing areas of South Africa, were monitored through the 1984/85 growing season. Twelve plant-parasitic nematode species were found. Nine were new reports on sunflower in Southern Africa: *Pratylenchus zae*; *Pratylenchus crenatus*; *Pratylenchus penetrans*; *Rotylenchus unisexus*; *Rotylenchulus parvus*; *Helicotylenchus dihystrera*; *Paratrichodorus minor*; *Paratrophurus anomalus* and a *Trophurus* species (undescribed species).

Six of these species: *P. crenatus*; *R. unisexus*; *R. parvus*; *H. dihystrera*; *P. anomalus* and the *Trophurus* species have not been found on sunflower in any part of the world before. The other three species were confirmed as parasites of sunflower in South Africa: *Scutellonema brachyurum*; *Meloidogyne javanica* and *Meloidogyne incognita*.

GG.2132/20/1/2:

THE OPTIMAL ENVIRONMENTAL CONDITIONS PREDISPOSING THE ATTACK OF THE MOST IMPORTANT NEMATODE SPECIES ON SUNFLOWER. 1984-1989

C. Bolton

This project was initiated after it was suggested that nematodes were suppressing yields of oil-seed sunflower in South Africa. Fourteen farms were sampled five times through the season. A greenhouse trial was carried out to test the pathogenicity of *Pratylenchus zae* on sunflower.

There were comparatively low numbers of nematodes in the soil and roots from the survey, and sunflower was found to be less susceptible to *P. zae* than were either sorghum or maize in the greenhouse trial. Evidence from the survey also showed sunflower to be fairly resistant to *P. zae* and the *Meloidogyne* species (*M. javanica* and *M. incognita*). *Paratrichodorus minor* was the only species found to increase in numbers until the end of the season. It is proposed that nematodes, with the possible exception of *P. minor*, are generally not causing yield reductions of sunflower in South Africa, and that the possibility exists of using sunflower as a fairly nematode resistant crop in a crop rotation system.

Some ecological factors had striking effects on nematode populations. Many species showed a preference for a particular soil-type. There were more species and higher numbers in the clay soils than in the sandy soils, although the *Meloidogyne* species were found in the sandy soils only. A sorghum crop history caused a peak in nematode numbers at the planting of the subsequent sunflower crop. These numbers dropped rapidly until the end of the season, under the sunflower. A late planting date suppressed the number of nematodes throughout the season, while an early planting date suppressed the number at the beginning of the season only.

The greenhouse trial did not show a significant difference in numbers of *P. zae* or rates of reproduction in the roots, between sunflower cultivars, although AS 504 showed a greater sensitivity with a significant decrease of root dry mass of inoculated plants. From the survey there was an indication, however, that there was a differential susceptibility of cultivars to *P. zae*. It also appears that all the cultivars used in the survey attracted the *Meloidogyne* species larvae but inhibited their development, thereby acting as a trap crop for these species.

• *Crop science*

GG.2132/30/1/3:

THE ABILITY OF SUNFLOWER CULTIVARS AND BREEDING LINES TO EMERGE AT HIGH TEMPERATURES. 1983-1986

H.L. Loubser

Effects of temperature and moisture stress on the germination and emergency of sunflower seeds were evaluated. Two trials were done under controlled conditions. Firstly a germination trial with five cultivars, three temperatures, namely 15 °C, 25 °C and 35 °C and four moisture stress levels namely 0, -500, -1 000 and -1 500 kPa.

The second trial was a pot trial with the same cultivars; four temperatures, namely 15 °C, 23 °C, 31 °C and 39 °C and four moisture stress levels namely 0, -49, -196 and -441 kPa. The results indicated that temperatures between 28 °C and 31 °C were not too high for germination and emergence of sunflower seed on condition that the moisture stress does not exceed -500 kPa. At a temperature of 39 °C the emergence was less than 30 %.

Differences among cultivars could not be ascribed to genetic differences because too many environmental factors were likely to differ among cultivars prior to commencement of the trials.

GG.2132/30/1/4:

REACTION OF SUNFLOWER CULTIVARS ON VARYING LEVELS OF SOIL ACIDITY. 1983-1988

J. Chapman

The effects of liming on the growth and yield of 12 sunflower hybrids was studied over a five-year period at Dundee Agricultural Research Station, Natal. The trials were conducted on soils of the Avalon form, Avalon series. Soil pH levels of 4 (L_0), 5 (L_1) and 6 (L_2) were established by applications of calcitic lime. The soil was fertilised to a level considered adequate for sunflowers.

The pH levels remained higher than expected and the percentage aluminium saturation in the control plots was negligible. Thus it was difficult to assess a differential cultivar response to variations in soil pH and percentage aluminium saturation. However, the main effects of liming for each season and also the overall means derived from the seasonal means, indicated that seed yield increased from L_0 to L_1 , suggesting that liming to pH 5.0 was beneficial. The seed yield depression which occurred between L_1 and L_2 suggested that the high application of lime induced a nutrient deficiency or imbalance. Liming to a pH of 4.5 is recommended for sunflowers on an Avalon soil.

Means derived from the results of all seasons indicated that HV 722 and SO 234 gave the best results at the L_0 treatment. SO 209 and SO 203 also did well at L_0 . HV 722 and AS 504 gave the highest seed yields at L_2 suggesting that these cultivars are more tolerant to the possible nutrient deficiency or imbalance at this treatment or had a higher pH requirement.

The liming treatments did not affect phasic development or plant height to any great extent. One hundred seed mass was affected by the lime treatments during one season only and followed a similar response pattern to that of seed yield for the same season.

SOYBEANS

• *Physiology*

GG.2133 03 1 1:

THE EFFECT OF PLANTING DATE ON THE RESPONSE OF SOYBEAN CULTIVARS AT DIFFERENT PLANT POPULATIONS. 1983-1988

J. Chapman

The object of this investigation was to ascertain if the soybean grain yield could be increased by the manipulation of plant population, plant arrangement and planting time using two cultivars, Oribo and Cutler. The trial was conducted at the Agricultural Research Station, Dundee, Natal from 1978/79 to 1986/87 on a Doveton soil series. A randomised factorial design was used. Optimum production practices were used.

On average Oribo took the greatest number of days to senescence. It also showed the greatest decline in response to delayed planting. Main effects indicated that emergence date had no effect on plant height. Oribo was the tallest cultivar. The high plant population gave the tallest plants in both cultivars.

On average node number per plant was reduced by increasing plant populations but plant arrangement had no effect. Node number per plant declined in both cultivars in response to delayed planting but was more marked in Oribo. Node number per unit area was not affected by emergence date in Cutler but in Oribo there was a marked decline in response to delayed planting. On average the highest plant population gave the greatest number of nodes regardless of plant arrangement but showed the greatest decline at the last

emergence date. Cutler had the greatest number of nodes at the high plant population regardless of row spacing. In contrast Oribi gave the highest node number at narrow rows regardless of plant population. The differences observed between node number on a per plant and area basis, indicates that the soybean is to a certain extent able to maximise on available space, but there are limits to this compensatory process. On average high plant population branch reduction was greater at wide than at narrow rows. Delayed planting reduced branch number in both cultivars.

On an area basis seed number was markedly reduced by delayed planting in both cultivars. Seed number was positively associated with plant population but plant arrangement had no effect on this variable. Cultivar main effects indicated that Cutler gave the highest seed yield but showed a marked decrease in response to delayed planting which was not apparent in Oribi. Neither plant population nor plant arrangement had any effect on seed yield. Differences in the variables associated with seed yield owing to population treatments were not reflected in seed yield. This suggests that a given area can only produce a certain amount of seed even when variables conducive to high seed yield are at optimum level. Moisture availability or nutrients supply may have been limiting factors.

In both cultivars the date of emergence had no effect on leaf dry matter. The high plant population produced the greatest amount of leaf dry matter. These results were not reflected in seed yield suggesting that leaf dry matter was excessive or that other factors were involved.

On average lowest pod height was greatest in Oribi. Pod height declined in both cultivars (more markedly in Cutler) in response to delayed planting. Pod height of Oribi was satisfactory in all treatments but in Cutler was only adequate at the highest plant population at wide row spacing.

The results indicate that it would not be possible to increase seed yield by manipulation of plant population/plant arrangement within the range of treatments applied in this study.

• Nutrition

GG.2133/05/1/2:

THE DETERMINATION OF CRITICAL VALUES FOR SOIL PHOSPHORUS WITH SOYBEANS. 1983-1988

J. Chapman

The objective of the trial was to investigate the growth and yield of the soybean at two levels of lime (L0 = no lime and L1 = 8 000 kg ha⁻¹); four levels of nitrogen (N0 = 0, N1 = 120 kg ha⁻¹ and N3 = 180 kg ha⁻¹), and four levels of phosphorus which had been applied to previous experiments to give P0 = 2, P1 = 6, P2 = 11 and P3 = 20 mg kg⁻¹ of P. The N fertiliser was applied in the form of urea as a side dressing split into two equal amounts applied during the growing season.

The trial was conducted at the Dundee Agricultural Research Station, Natal, from 1981/82 to 1984/85. The experimental design was fully randomised blocks incorporating split plots. During 1981/82 the plots were split for cultivars, and Forrest and D75/12034 were planted. During 1982/83 Hutton was planted. For succeeding seasons Forrest was planted throughout. The cultivars responded similarly to the lime and fertiliser treatments. Therefore no distinction between cultivars is made in this summary. During 1982/83 the plots were split for lime L1 (4 000 kg ha⁻¹) versus a no lime L0 treatment. The following season (1983/84) a further application of 4 000 kg ha⁻¹ of lime was made to the limed plots. Thereafter, no further applications of lime were made.

Nitrogen fertilisation had little effect on the growth and yield of the soybean. This may have been due to adequate amount of N being supplied by the nitrogen fixing *Rhizobia*. Liming affected N fertilisation. At L0 yields were progressively reduced by increasing amounts of N. This was probably due to the acidifying effect of high amounts of N inducing high soil Mn levels which had a toxic effect on root growth, nodulation and nutrient uptake.

Liming and P fertilisation improved the growth and seed yield of the soybean. Liming markedly improved the growth and yield at low P levels possibly by improving the availability and/or uptake of P. This effect was not so apparent at the high P levels, probably because of adequate amounts of P being available from the P fertiliser. The results indicate that the soybean does not have a high P requirement in order to give satisfactory seed yields. Liming and P fertilisation resulted in larger plants which had more fruiting sites and higher yields. This was confirmed by highly significant positive correlations between plant height, total harvested mass, 100 seed mass and seed yield.

• Crop science

GG.2133/30/1/5:

RESPONSE OF SOYBEAN CULTIVARS TO ALUMINIUM UNDER FIELD CONDITIONS. 1982-1987

J. Chapman

Twelve soybean cultivars of various maturing groups were tested at three soil pH (KCl) levels, viz 4.0, 5.0

and 6,0 established by applications of calcitic lime. The trials were conducted over a five-year period at Dundee Agricultural Research Station, Natal, on soil of the Avalon form, Avalon series. During the 1982/83 season yields were poor due to drought and there were no differences between any of the treatments.

The pH levels in the control plots remained higher than expected and the percentage aluminium remained low. The percentage aluminium saturation in the lime treatments was negligible. Thus it was difficult to assess differential cultivar response to variations in soil pH and percentage aluminium saturation. However, trends in cultivar response were apparent. With regard to seed yield four basic responses were observed:

- (i) an increase in seed yield with each increase in lime level, e.g. Forrest;
- (ii) an increase in seed yield from L_0 to L_1 then a decrease from L_0 to L_1 suggesting a nutrient imbalance or deficiency induced by the high lime level, e.g. Prima and Geduld;
- (iii) an increase in seed yield from L_0 to L_1 then a levelling off between L_1 to L_2 indicating a similar but less marked response than (ii), e.g. Duiker and Sabie;
- (iv) little or no response to the liming treatment, e.g. Edgar. The response of some cultivars varied with seasons.

In most cases, C43 and Prima excepted, seed yield was positively associated with total harvested yield indicating that the factors which affected plant growth also affected seed yield.

The positive response to liming found in most cultivars from L_0 to L_1 indicated the beneficial effects of liming on the Avalon soils. The yield depression which occurred in many cases between L_1 and L_2 suggested that high applications of lime induced a nutrient deficiency or imbalance. Liming to a pH of 4,5 is recommended for soybeans on an Avalon soil.

DRY BEANS

• Pathology

GG.2134/19/1/3:

PRODUCTION OF DISEASE-FREE DRYBEAN SEED VIA MERISTEM AND OTHER *IN VITRO* CULTURE METHODS. 1984-1989

P.C.W. van der Walt

A description is given of a technique for the production of bacteria-free kidney bean plants. Infected *Phaseolus coccineus* seeds were germinated under sterile conditions. The shoot apical meristems were then aseptically isolated and transferred to a nutrient medium. Multiple bud regeneration was induced from bean meristems at low cytokinin and high auxin levels.

The buds were aseptically separated and placed on a medium supplemented with indoleacetic acid. Whole plant regeneration of 72% occurred. These plants were screened for the presence of *Pseudomonas syringae* pv. *phaseolicola* and *Xanthomonas campestris* pv. *phaseoli*. No pathogenic bacteria were found.

• Crop science

GG.2134/30/1/7:

RESPONSE OF DRY BEAN CULTIVARS TO DIFFERENT SOIL ACIDITY LEVELS TO DETERMINE ALUMINIUM TOLERANCE. 1982-1987

J. Chapman

Twelve dry bean cultivars were tested at three soil pH (KCl) levels, viz 4,0 (L_0), 5,0 (L_1), 6,0 (L_2) which were established by application of calcitic lime. The trial was conducted over a four-year period at the Agricultural Research Station, Dundee, Natal, on soil of the Avalon form, Avalon series.

The pH levels in the control plots remained higher than expected and the percentage aluminium saturation low. The percentage aluminium saturation in the limed plots was negligible and of no account. Thus it was difficult to assess differential cultivar response to variation in soil pH and percentage aluminium saturation. However, trends in cultivar response to variations in soil pH were apparent. With regard to seed yield three basic types of response were observed:

- (i) an increase in seed yield between L_0 and L_1 and then
- (ii) a sharp decline from L_1 to L_2 , e.g. Bonus and Kamberg;
- (iii) little or no response to liming, e.g. PC 74-C60. BAT 1198 was the cultivar most sensitive to low soil pH.

The increased seed yield which occurred in most cultivars at L_1 was probably due to the beneficial effects of liming at this level. The seed yield decline between L_1 and L_2 may have been due to a nutritional deficiency or imbalance induced by the higher level of liming.

Overall Carioca and A 90 gave the highest seed yields. Kamberg also yielded well. NEP 2 and

Nuweveld gave the lowest seed yields. The 100 seed mass of most cultivars tended to follow a similar response to that of seed yield suggesting that the same determining factors were operative in the case of both variables. On average Bonus had the heaviest seeds. A 83, Carioca and Nuweveld also had heavy seeds. BAT 1198, Kamberg, Kommpasberg, NEP 2 and Swan Valley had the lightest seeds.

A soil pH of 4,5 appeared to be adequate for the dry bean plant on this Avalon soil. Swan Valley had a greater tolerance to soil waterlogging than the other cultivars in the trials.

Other agronomy crops

COTTON

• Physiology

TK.2141/03/1/1:

STOMATAL CLOSURE AFTER CUT-OUT PROMOTES PREMATURE LEAF SENESCENCE
IN COTTON (*GOSSYPIMUM HIRSUTUM* L.). 1983-1987

N.J.J. Combrink

Six stress treatments were applied to cotton, at a late stage of development, when a heavy boll yield had already formed. Home-made pots, containing nutrient solution sealed off from outside air, were used. Low levels of K and N, insufficient root aeration, application of abscisic acid (ABA) and a PEG 6000 induced moisture stress of about -200 kPa were compared with a control. The trial was conducted out of doors to allow sufficient radiation for production of anthocyanin.

The severity of the applied stresses affected the development of red leaves. With a very drastic stress, obtained with ABA in one replication, the leaves wilted and dehydrated before losing all of their chlorophyll. The milder stresses allowed total loss of chlorophyll in affected leaves, thus unmasking the yellow and red pigments before premature abscission. A leaf senescence index (LSI) was determined and correlated with the average total diffusive resistance during the four-week stress period.

A significant relationship, explaining 40,5% of the variation, was illustrated between these two variables, indicating that stomatal closure after cut-out may induce premature leaf senescence. A stronger but unexpected negative correlation was found between the average total diffusive resistance and the P content of the cotton seed produced.

TOBACCO

• Pathology

TK.2142/19/1/5:

CHEMICAL CONTROL OF BLACK ROOT ROT IN TOBACCO. 1980-1986

G.C. Prinsloo

Benomyl is the only fungicide registered for the control of black root rot (*Thielaviopsis basicola*) in tobacco. As a result of the continuous use of this chemical, effective control is no longer obtained at the registered dosage.

The aim of this study was therefore to find other chemicals which would control black root rot.

Since 1980 various chemicals were tested for their activity against *T. basicola* in laboratory, greenhouse and seedbed trials. Of all the chemicals tested, propiconazole, triadimenol and flusilazol most effectively controlled black root rot in tobacco.

TK.2142/19/2/1:

TOMATO SPOTTED WILT DISEASE OF TOBACCO. 1981-1987

R.J. van Wyk

Curaterr soil treatment at planting followed by regular applications of mercaptothion or endosulfan sprays proved to be more effective than curaterr, mercaptothion or endosulfan as a single treatment. The control obtained however is not adequate and chemical treatments together with resistant varieties may prove to be more efficient.

Naudé first reported good nematode control with (dichloropropane-dichloropropene mixture) D.D. in South Africa in 1947, and during 1951 (ethylene dibromide) E.D.B. was also recognised as a good nematocide. Since then, the effectiveness of these two fumigants on soils with different clay contents and nematode population levels has frequently been questioned. The possibility of an increase in undesirable halogen content in the cured tobacco leaves also gave rise to many disputes. Later developments in application techniques, and new and easier to apply nematocides such as granular types with a shorter waiting period between application and planting became available, and the selection of the most suitable nematocide for specific circumstances became difficult.

The aim of this study was to compare the efficacy of most of the available nematocides on soils with high as well as low clay content at high population levels over a few years. The possible benefit of using two different nematocides at full dosage at planting time was also looked into. Parameters used to determine effectivity were a fixed infection index ranging from 0,0-5,0 of the roots of the treated plants after the crop was reaped. The plots were reaped, cured, graded and evaluated and the yield of each plot calculated. In this way yield and quality could be determined. Random samples from each plot were taken and analysed for nitrogen, phosphate, potassium, calcium, magnesium and chlorine content after curing.

The nematocides used in these experiments were Ethylene dibromide (E.D.B.), Aldicarb (temik), Fenamiphos granular (nemacur), Fenamiphos C.C. (Nemacur liquid), Oxamyl (vydate), dichloro-propane-dichloropropene mixture (D.D.), Carbofuran (curaterr) which were used single or in combination with E.D.B. The cultivar TL38 was used and each experiment was carried out for at least three years.

The results obtained proved that E.D.B. and D.D. are after so many years still the best nematocide available according to nematode control obtained, yield and income. E.D.B. proved to be better on high clay content soils than D.D., but D.D. on the other hand, was better in the more sandy soils. In a few experiments on high clay content soils D.D. application had the detrimental effect of increasing the chlorine content of the cured tobacco leaves. In sandy soil this phenomenon was not evident.

Granular nematocides such as nemacur and temik have advantages over D.D. and E.D.B. in so far that they are easier to apply and require a much shorter waiting period, but these two chemicals are not effective against higher initial nematode populations. Vydate, although one of the few nematocides with the ability to be translocated to the roots after applying as a foliar-application was not effective as a single chemical on its own. The granular curaterr was also not effective by itself. It is evident from results obtained in this investigation that there is scope for manipulation of chemical control in tobacco fields with a known nematode history but where the nematode population level is not known E.D.B. should be used in a soil with a high clay content and E.D.B. or D.D. could be used in a sandy soil with or without vydate as a supplementary treatment.

• *Technology*

The prevailing weather conditions in the areas where air-cured tobacco is traditionally produced in the Republic of South Africa is often dry with high maximum temperatures. This does not favour the proper curing of air-cured tobacco and invariably it will cure unripe and green in open barns. As the curing process of air-cured tobacco involves many chemical changes that have to occur within the leaves during the curing process, it is essential that the rate of dessiccation should not exceed the rate of these chemical changes. In view of this requirement, curing trials with air-cured tobacco were conducted in curing barns where the ambient relative humidities were artificially modified by the introduction of water sprayers or mist blowers or by restricted ventilation in curing modules. The following barns with modifications and modules were investigated:

1. Open two-tier barn.
2. Brick-walled closed two-tier barn.
3. Corrugated iron-walled three-tier barn.
4. As 3 but fitted in the centre with a six-meter suspended vertical metal duct, complete with down-draft air blower and water sprayers.
5. As 3 but fitted directly under the roof with Mellor Bromley, type HD, horizontal mist blowers each with an effective radius of three meters.

6. Plastic tunnel-module erected in an open barn with humidity control at approximately 70 %.
 7. Underground cellar-module with humidity control at approximately 70 %.
 8. Temperature and humidity controlled module at 25 °C and 70 % r.h., respectively with controlled ventilated airflow at a rate of approximately three meters per minute.
- Physiologically ripe air-cured tobacco, *Nicotiana tabacum* L. cv. Barracao was either stalk-cut and cured or leaf primed and cured. After curing the tobacco was graded and priced.

It was concluded that:

1. The curing of air-cured tobacco in an open barn is not recommended as this practice results in too much wind-damaged and unripe green tobacco which is not marketable.
2. Applications of moisture with the aid of water sprayers or mist blowers is also not recommended on account of a too high incidence of barn-rot in the bottom tiers.
3. An uninsulated three-tier barn with a corrugated iron roof results in too great temperature and moisture differentiations between the tobacco tiers. A two-tier barn will cure tobacco more uniformly with respect to colour and ripeness.
4. Freshly harvested tobacco leaves should first be wilted before any measure of moisture control is applied.
5. Priming individual leaves at the optimal stage of physiological maturity, according to stalk position, results in a higher percentage of marketable tobacco, price and income as compared to stalk-cured tobacco.
6. The optimal conditions for the curing of air-cured tobacco in a controlled ventilated environment is 20 to 25 °C and 70 % r.h.
7. A positive correlation exists between the percentage, marketable tobacco and the average price thereof.

• Chemistry

TK.2142/53/2/4:

PHYSICAL AND CHEMICAL PROPERTIES OF TOBACCO GRADES. 1979-1987

J.G. Nel

Tobacco is graded according to its organoleptic properties as determined by leaf size, colour, texture, aroma and the presence or absence of physiological disorders. It was the aim of this study to relate these organoleptic properties with the chemical compositions of the various styles and grades of tobacco in order to find scientific substantiation for these organoleptic expressions.

Samples of various grades of flue- and air-cured tobacco's were collected at tobacco co-operatives and subsequently analysed for chemical components which are related to tobacco quality.

Most of the flue-cured tobacco grades analysed were of good quality. The sugar contents varied between 18 and 24 % while the alkaloid levels ranged from 1,4 to 1,8 %. According to the grade descriptions and organoleptic appearance of these grades everything pointed to the fact that the amount of nitrogen fertiliser applied was in good balance to the growth and development of the leaves, irrespective of the colour of the tobacco, viz lemon, orange or light mahogany. It was also clear that the maturity of the leaves coincided with the ripeness thereof at the time of harvest.

In the grades where the maturity did not coincide with the ripeness the tobacco was of poorer quality and pointed to an imbalance in the nitrogen fertilisation programme. Tobacco leaves that were mature but unripe at the time of harvest developed a close grained texture during curing and exposed either a reddish or greenish discoloration. The darker shades invariably had high levels (more than 1,8 %) of alkaloids which is the result of a too high nitrogen fertilisation programme. Tobacco leaves that were immature but ripe at the time of harvest also developed a close grained texture during curing and showed a pale or greyish discoloration with a low alkaloid content (less than 1,4 %) together with a short leaf length (less than 305 mm) which is immature and close-grained. All these tobacco's were under-fertilised with nitrogen. The tobacco with the colour variation, pale or greyish, invariably had high chloride concentrations.

Tobacco with a good potential quality but which was cured too rapidly in the bulk-barn, thus not allowing sufficient time for the leaves to ripen properly, also cured to a close grained texture on account of a too high starch content.

In air-cured tobacco it was found that the percentage of nitrogen and alkaloids increased with ascending stalk position while the potassium content decreased. As the colour of the tobacco becomes darker the nitrogen content increased while the sugar percentages decreased. Poorer quality tobacco is associated with malnutrition as it contains less nitrogen, alkaloids, phosphorus and potassium while the chlorine content can be high.

In a study with flue-cured tobacco, produced in the MKTV production areas it was found that high chlorine levels remain a problem. During seasons of drought and high nitrogen fertilisation the alkaloid content of the tobacco was invariably high.

HORTICULTURE RESEARCH

Tuber crops

POTATOES

• Pathology

GS.2411 19 1 7:

CONTROL OF ANTHRACNOSE ON POTATOES. 1985-1987

L. Marais

The aim of this study was to identify a fungicide or combination of chemicals which will control anthracnose (*Colletotrichum coccodes*) on potato tubers.

Forty different fungicides were evaluated in different *in vitro* tests for the control of anthracnose. The most promising chemicals were tested in different trials, in which infected tubers were dipped and cold stored for a time, as well as in field trials.

Five promising fungicides were identified with the filter paper-disc plate technique, namely thiram, fentin hydroxide, captafol (wp and sc formulations) and prochloraz. The tempo at which different fungicides diffuse through the agar can differ. Therefore with the filter paper-disc plate technique one can discriminate against fungicides that diffuse slowly through the agar.

All the fungicides were again tested by growing the fungus on a medium in which the fungicides had been suspended. Prochloraz had a fungicidal effect on anthracnose. A test product of Agricura and thiabendazole + 8 hydroxyquinolene sulphate inhibited growth of the pathogen. Thiram, fentin hydroxide and captafol (wp and sc formulations) had a weak fungistatic effect on the growth of the fungus.

The promising fungicides were tested in different *in vivo* tests. None of the fungicides controlled anthracnose in any of these tests.

GS.2411/19/3 8:

POTATO LEAFROLL VIRUS IN POTATO: PURIFICATION PROCEDURES AND ANTI-SERUM PREPARATION. 1983-1987

P.J. Prins

The purpose of the research was the preparation of a high quality anti-serum against a South African isolate of potato leafroll virus for indexing potatoes.

A South African source of potato leafroll virus was isolated and repeatedly transmitted by means of single aphids to *Physalis floridana*. The virus was re-introduced into potato and secondarily infected tubers were planted in a glasshouse. Infected leaves of this source were harvested and stored in a freezer.

Virus extraction was possible by means of the addition of laboratory grade enzymes in the extraction buffer. Maceration of the phloem tissue with cellulase TC and pectinase rohament P5 was comparable to results obtained with Driselase but at a much lower cost and virus yield in successive purification steps were equal or better than those obtained with Driselase.

An antiserum with a titre of 1:2048 was prepared using virus purified by this method. No reaction with healthy plant sap was detected.

Tissue maceration with an industrial grade enzyme, Coloredase was efficient but resulted in the disruption of virus particles and therefore it was unsuitable in further purification steps.

• Pests

GS.2411 20 2 2:

CHEMICAL CONTROL OF POTATO TUBER MOTH IN STORED POTATOES. 1979-1984

H.D. Steenekamp and K.C. Daiber

Potato tubers may be stored from a few days to several months. During this period larvae of *Phthorimaea operculella* (Zeller) in infested tubers may complete the life cycle and female moths may lay eggs on uninfested tubers.

After a storage period of 81 days from January to April in an open store, tuber moth, *Phthorimaea operculella* (Zeller) had damaged 15% of a batch of potato tubers which had come from the lands almost

without infestation. This was observed at a farm producing seed potatoes. The problem is more serious where potatoes reach the store with a high percentage of infestation, and where the insect is allowed to multiply unabated.

Experiments showed that the development of the immature stages of the insect was retarded at 4 ° to 7 °C and that a large percentage was killed when tubers were stored at these temperatures for 84 days and longer. In laboratory experiments treatment of tubers with insecticides containing methomyl, deltamethrin, and permethrin protected tubers from infestation and also killed larvae inside the tubers. The sex pheromone of the tuber moth was used in sticky traps. Two traps were kept for a year, one inside and one outside a storage shed. Male moths were caught at both localities throughout the year. The numbers caught at a specific time of the year are an indication of the presence and activity of the insect. Most were caught in summer. Moths were caught for several weeks after the floor of the storage shed was free of stored potatoes.

The purpose of the research on this facet was to establish the importance of the tuber moth problem in stored potatoes. Certain insecticides were tested, while the life of the insect at room temperature and at 4 ° and 7 °C in cold storage was also studied. The sex pheromone of the insect was used in sticky traps to monitor the male flight.

It was shown that methomyl, deltamethrin and permethrin protect tubers from tuber moth infestation by killing larvae which are about to enter tubers and also killed larvae already inside the tubers.

The results showed that the development of immature stages is retarded at 4 to 7 °C and that a large percentage is killed after exposure for 84 days and more. It was also noted that tubers come into the storage shed free or almost free from tuber moth if the insect is thoroughly controlled in the land and if the foliage is removed from the plants some weeks before harvest. It was also noted that tubers kept in an open storage shed at prevailing temperatures from January to April revealed 15 % infested tubers.

Male moths were taken from sticky traps at weekly intervals. Moths were caught in and around the potato shed throughout the year. Higher numbers were caught in summer than in winter. Several weeks after the storage shed was cleaned moths were still caught in the trap inside the shed.

• Crop science

GS.2411 30 2 11:

AN INVESTIGATION ON THE EFFICIENT UTILISATION OF POTATO TUBERS. 1983-1987

B.J. Pieterse

High production cost is a major problem for the potato industry in South Africa, with the cost of seed as the largest component. To limit this production cost, seed potatoes should be produced and utilised more efficiently.

Two field experiments were planted at the Vegetable and Ornamental Plant Research Institute to investigate the cutting of seed tubers of the cultivars BPI and Vanderplank under South African conditions. In one experiment the performance of whole, halved and quartered seed tubers were compared. The mass of the three seed types was the same after cutting. Three mass classes were used, namely 100, 150 and 200 g. Results showed that the cutting of the tubers as such had no adverse effect on the production potential of the seed pieces.

In the second experiment, the performance of whole seed tubers (120, 210 and 300 g) was compared to that of half seed pieces (60, 105 and 150 g) at 200 and 300 mm inter-plant spacings. From the results it was concluded that the yield from half seed pieces compared favourably with that of whole seed tubers. Yields from cut tubers of the cultivar Vanderplank were reduced to a greater extent than yields of BPI. This was ascribed to the lower stem populations produced by the seed pieces of Vanderplank. One could compensate for the lower stem populations from seed pieces of Vanderplank by closer spacing of the seed pieces.

A pot experiment was conducted to investigate the influence of the seed piece on growth under controlled conditions in growth cabinets. Seed pieces with masses of 20 or 50 g each were planted in vermiculite under continuous light, continuous dark or continuous dark with nutrient solution in the growing medium. The application of nutrient solution to the etiolated plants was only beneficial to growth from the 50 g seed pieces and did not have any effect on growth from 20 g seed pieces. Accumulated reserves in the seed pieces had a definite effect on growth but additional nutrient elements were also necessary to accomplish optimal growth.

A double pot technique was developed to remove seed tubers from growing plants. Where 30 g seed pieces were removed five weeks after planting, a significant decrease in stem length and the dry mass of stems, roots and tubers occurred. The removal of 10 g seed pieces were utilised by the growing plants within five weeks after planting.

This study showed that definite possibilities exist for improved usage of available seed potatoes in South Africa, either by the use of small tubers or by cutting large tubers.

Vegetables

ONIONS

• *Upgrading*

GS.2422 07 1 1:

THE BREEDING AND SELECTION OF CALEDON GLOBE AND AUSTRALIAN BROWN ONIONS. 1976-1987

J.J.B. van Zijl

The aim was to improve the keeping quality and uniformity of Caledon Globe and Australian Brown. Certified Caledon Globe and Australian Brown were subjected to three cycles of recurrent selection. During this programme attention was paid to bulb-shape, -colour, -hardness and the thickness of scale leaves. Selection was applied against bolters, split bulbs, purple and white bulbs. Selection for keeping quality was done after storage for eight months at room temperature.

In 1985 an improved source of Caledon Globe breeder-seed was handed to the Director of Plant and Seed Control. Similarly an improved source of Australian Brown breeder-seed was handed over in 1986. These seed sources met all the requirements set by the Directorate of Plant and Seed Control.

A new cultivar Roël was obtained in the process of improving Caledon Globe. The bulbs are very firm and darker in colour than those of Caledon Globe, but not quite so dark as those of Australian Brown. The bulbs of Roël store exceptionally well.

Some other good lines were also obtained and are available for use in the F_1 hybrid programme.

• *Crop science*

GS.2422 30 2 1:

THE INFLUENCE OF SEED SIZE AND CERTAIN PRODUCTION PRACTICES ON YIELD AND QUALITY OF ONIONS. 1984-1987

A.G. Comrie

The object of this study was to investigate the effect of cutting back the leaves of seedlings in the seedbed (pruning) or at transplant (topping) on the yield, growth and keeping quality of 'Caledon Globe' and 'Australian Brown' onions sown on three dates in 1984 and 1985. Included in the study was an investigation of the influence of seed size and sowing density on the yield and quality of these two cultivars.

Both defoliation treatments resulted in a decreased bulk size and poorer keeping quality. Averaged over two years, the yield reduction caused by topping at transplant increased from 7.4% with a 16 April sowing to 20.2% at a 22 May sowing, while that caused by pruning varied between 14.5% and 16.5%. Although both defoliation treatments resulted in significant increases in split bulbs at all three sowings of 1985 they did not appear to affect bolting greatly.

Both sowing date and defoliation treatments affected the incidence of sprouting in bulbs stored for 25 weeks at ambient temperature (12-22 °C). Averaged over cultivars and years, sprouting of bulbs of control plants increased from 34% with a 16 April sowing to 64% with a 22 May sowing. The respective figures for bulbs of pruned plants were 75% and 87% and for bulbs of topped plants 72% and 88%.

Growth in the field was monitored by means of samples taken at 10- to 15-day intervals. Leaf area showed the greatest treatment response. Differences between treatments and cultivars were expressed in terms of individual leaf size rather than leaf number. Mean leaf area over the growing season was negatively correlated with sprouting ($r = -0.6692$ $P = 0.001$) and mass loss in storage ($r = -0.6274$ $P = 0.001$) and positively correlated with bulk dry mass at harvest ($r = 0.6115$ $P = 0.001$) and the incidence of split bulbs ($r = 0.4478$ $P = 0.01$) and bolters ($r = 0.5788$ $P = 0.001$).

Higher sowing densities resulted in smaller plants and lower yields. Averaged over seed size and cultivars a sowing density of 3000 seeds m^{-2} produced a yield of 51.10 t ha^{-1} compared with 41.83 t ha^{-1} from 4500 seeds m^{-2} and 38.15 t ha^{-1} from 6000 seeds m^{-2} ($P = 0.05$). These sowing densities produced 3.1%, 4.4% and 5.5% split bulbs, respectively. Seed size did not affect yields except at the highest sowing density where 2.5 to 3.0 mm seeds produced a significantly higher yield than 2.0 to 2.5 mm seeds.

COLE CROPS

• Pathology

GS.2423 19 1 1:

A STUDY ON THE PHENOLOGY, EPIDEMIOLOGY AND CONTROL OF BLACKLEG
(*PHOMA LINGAM*) ON COLE CROPS: CABBAGE IN NATAL. 1984-1987

B.H. Boelema

Cabbage is one of the most important vegetable crops in Natal. When this study was initiated blackleg, a fungus disease, caused great concern to the farmers. The causal organism was known as *Phoma lingam*. During a survey, however, the sexual phase of the pathogen, hitherto unknown in South Africa, was discovered and therefore the pathogen had to be renamed (*Leptosphaeria maculans*).

In a study of the epidemiology of the disease it was found that ascospores did not play an important role, but that the epidemic almost always had its origin in contaminated seedlings. The importance of contaminated seedlings as a source of infection was confirmed in an experiment, in which inoculated seedlings were compared with inoculated "speedlings" (seedlings grown by specialised nurseries in seed trays). It was found that considerably more plants grown from seedlings than plants grown from "speedlings" became infected. The results of the experiment explained why the disease virtually disappeared in areas where farmers had started to use "speedlings" instead of seedlings.

The results of cultivar trials showed that disease resistance of leaves is not correlated with resistance of stems. Screening methods in which the degree of leaf infection is used as criterion for resistance are therefore useless if one wants to breed for stem resistance. Considerable differences in resistance were found between crops of the same cultivar grown from different seedlots. This is an important result, which should be taken into account when cultivar trials are planned. None of a great number of seed dressings tested reduced seed infection to the level required by the International Seed Testing Association.

ROOT CROP VEGETABLES

• Upgrading

GS.2424 07 2 1:

ROOT CROP VEGETABLES: BREEDING AND SELECTION OF CAPE MARKET AND
CHANTENAY KAROO CARROTS. 1982-1988

A.F. Coertze

The two fresh market carrot cultivars Cape Market and Chantenay Karoo were developed by means of positive mass selection to a degree of trueness to type and homogeneity acceptable to the Directorate of Plant and Seed Control.

The seed was sown annually and the carrots were harvested, evaluated and selected at the optimum stage of development. The selected carrots were planted for seed production on isolated plots protected from hail and pollinated by bees.

Carrot shape was found to be influenced to a certain extent by the temperature, population density, age, soil type and soil moisture. These factors were taken into consideration during selection.

Progress was made with regard to carrot shape, length and the percentage of bolters in Cape Market. Cape Market did not have the necessary genetic variability to allow further improvement of green shoulders and broad pith.

• Crop science

GS.2424 30 3 1:

ROOT CROP VEGETABLES: THE INFLUENCE OF SPACING ON SWEET POTATO
PRODUCTION. 1982-1986

C.P. du Plooy

During the course of this trial the effect of growth period as well as in-row spacing, on the yield and mass of sweet potato cultivars were monitored. During the first phase standard single rows, as well as double rows (alternately spaced, with approximately 250 mm between rows), were planted on ridges. Three different nitrogen levels were used to determine whether high plant populations require higher nitrogen applications.

During the second phase the interaction between spacing and growth period was determined.

Simultaneously the reaction of different cultivars on the treatments were evaluated.

At the end of the first phase it was clear that double rows, alternately spaced on ridges, with an in-row spacing of 600 mm, resulted in the highest marketable yield. Since there was no significant difference in yield between single and double rows, where plant populations were kept constant, an in-row spacing of 300 mm, single rows which are more practical than double rows, are optimal for fresh market production. Although there was no significant interaction between spacing and nitrogen fertilisation, increased nitrogen levels tended to produce higher yields.

In the second phase a clear relationship between growth period and spacing on the one side and yield and storage root mass on the other side were found. Both growth period and spacing have a direct effect on storage root mass and yield, and can be adjusted to meet certain size criteria. With a relative short to normal growth period (120 to 150 days) an in-row spacing of 300 mm is recommended for all local sweet potato cultivars. If the growing season exceeds 150 days, with cultivars which are inclined to produce large unmarketable storage roots, i.e. Ribbok, the size can be controlled effectively by an in-row spacing of 100 mm.

Storage root initiation was already completed at 90 days after planting. Spacing had a direct effect on storage root initiation and as the spacing increased more storage roots per plant were initiated. The process of storage root initiation and factors that may influence it are at present being investigated.

LEGUME VEGETABLES

• Upgrading

GS.2425/07/1/1:

LEGUME VEGETABLES: BREEDING AND SELECTION OF GREEN BEANS. 1975-1989
A.F. Coertze and A.A. van den Berg

A breeding programme for green beans (*Phaseolus vulgaris* L.) was initiated at Roodeplaat with the aim to breed bush bean cultivars which are well adapted to South African growing conditions and suitable for fresh marketing and processing.

The first cultivar Rolito was released mainly for fresh market production. Rolito has very straight, pencil thick pods and is suitable for packing, especially for export.

The other breeding lines which performed the best, originated from the winning combination (Seminolex Gallatin 50) F₁ x Thor.

In view of good performance in evaluation trials at Roodeplaat and other centres throughout the country, four more cultivars are to be released. The speckled seeded breeding lines 79H326 and 79H341 are to be released as Rolong and Rominole, respectively. While two white seeded breeding lines 79H301 and 79H236 are to be released as Rolatin and Roberg, respectively, for processing and fresh marketing.

As a bonus to the breeding work, a natural seed colour mutation was discovered in the black-seeded green bean cultivar Wintergreen during a planting for breeder seed production. The new white seeded Wintergreen is to be released as a new cultivar under the name Rowit.

• Pathology

GS.2425/19/1/2:

LEGUME VEGETABLES: A STUDY OF COMMON BLIGHT OF GREEN BEANS. 1984-1987
B.H. Boelema

Methods were developed for testing bean (*Phaseolus vulgaris* L.) cutlivars and breeding lines for resistance to common blight caused by *Xanthomonas campestris* pv. *phaseoli* (Smith) Dye. The methods were based on infectivity titrations. Leaves were inoculated by applying 5 µl drops of inoculum of low titer on 2-mm long cut wounds, two per blade. Pods were pricked with a microsyringe and at the same time a dose of low titer in a droplet of 2,5 µl was applied; two pricks were applied per pod.

The agreement between resistance as assessed according to these methods and resistance as observed in field trials or as reported in the literature was good.

SUNDRY VEGETABLES

• Crop science

GS.2427/30/2/1:

SUNDRY VEGETABLES: CULTIVATION STUDIES WITH LETTUCE. 1983-1986

C.P. Du Plooy

During the course of this trial the most important lettuce cultivars were evaluated to ascertain their suitability for cultivation during the different seasons of the year in the Transvaal Middleveld. This includes the use of 30 % shade cloth in an attempt to minimise the detrimental effect of extreme temperatures.

All cultivars evaluated, experience temperature-induced seed dormancy. The maximum temperature for acceptable germination, is in the range of 25 °C to 30 °C. At a temperature of 35 °C a dormancy is induced which can be lifted by reducing the temperature to 25 °C within 48 hours. Light irrigations during mid-day will keep soil temperatures favourable for germination with the result that, even in summer, this is not an unsurmountable problem in the Transvaal Middleveld.

Results once again pointed out that lettuce is a cool weather crop. The best sowing time in the Transvaal Middleveld is from March to the end of June, although certain cultivars are to some extent adapted for cultivation during the warmer seasons. However, no one can be considered as suitable for cultivation during mid-summer in this area. The reduction in yield during summer is mainly due to the production of smaller heads and an exceptional high percentage of decay, caused by bacterial infection (*Pseudomonas* and *Erwinia* spp.). No one of the cultivars evaluated was resistant or even slightly tolerant to bacterial infection. The use of 30 % shade cloth proved not to be economical justified and resulted in no significant increase in yield.

There are clear distinctions between the adaptability of cultivars to specific sowing times and the correct choice of cultivars is important. Cultivation of lettuce in the Transvaal Middleveld will, however, be limited to a great extent to the cooler seasons of the year, unless resistant cultivars and/or effective chemical control of bacterial diseases are made available. The results will soon be published in the *Roodeplaat Bulletin*.

Flowers and ornamental plants

PROTEAS

• Physiology

GS.2431/03/1/1:

PREVENTION AND CONTROL OF PHYSIOLOGICAL LEAF BROWNING OF *PROTEA*.
1984-1989

J.A. Brink

This study was undertaken to elucidate the involvement of the flower head of the inflorescence of *Protea neriifolia* in the observed browning of leaves.

Leaf browning is the most important post-harvest physiological disorder of several protea species. Removal of the flower head of *Protea neriifolia* R. Br. inflorescences delayed the onset of leaf browning and resulted in a reduced uptake of vase medium. The flower head is apparently responsible for the development of a stress condition in the leaf cells by inducing a cellular water shortage there, as well as by the withdrawal of nutrients. The leaves of inflorescences which are highly susceptible to leaf browning showed a typical climacteric respiration pattern while the leaves of inflorescences resistant to leaf browning respired at a much lower, but constant, rate over the entire sampling period.

The effect of sucrose and 8-hydroxyquinoline sulphate (8-HQS) on leaf browning of harvested *P. neriifolia* inflorescences in a vase solution, was examined. Results using only sucrose in the vase solution showed that concentrations of up to 10 g/l delayed the onset of leaf browning effectively. Concentrations greater than 20 g/l were harmful and accelerated leaf browning. The onset of leaf browning was delayed by the 50 and 100 mg 8-HQS solutions and the browning percentage was even further reduced by combining 5 g sucrose and 50 mg 8-HQS/l in the vase solution. A 5-g sucrose/l solution raised the respiration rate of leaves while 50 mg 8-HQS/l suppressed it.

Harvested stems of *P. neriifolia* were placed in a vase solution containing labelled ^{14}C -sucrose (U^{14}C) for 18 hours. A significant quantity of ^{14}C accumulated in the flower head after 12 hours.

A polyethylene cover of the flower head reduced flower head transpiration and lowered the browning percentage. The lowest leaf browning percentage was observed on inflorescences which were covered for a period of 3 days after harvest.

• Crop science

GS.2431/30/1/1:

COLLECTING, MAINTAINING AND EVALUATION OF PROTEA RESEARCH MATERIAL.
1975-1985

G.C. van den Berg

This work was undertaken to exploit the natural genetic sources of the South African Proteaceae for commercial purposes. The material collected, established and evaluated by the Vegetable and Ornamental Plant Research Institute at Riviersonderend (Tygerhoek Experimental Farm) totalled 151 species of 13 genera. From these, 6 new species were chosen in addition to the existing 14 species, for the purpose of commercial production under cultivation. This was done with the close co-operation of the protea export industry.

These species are now becoming established products of the industry and are also being upgraded genetically in the official breeding programme. The work has therefore made a significant contribution to satisfying the strongly increased demand for a larger variety of marketable flower items. A variety of Australian Proteaceae (56 species) was also screened; 7 *Banksia* and 1 *Telopea* species have been selected provisionally as potentially useful items.

The work has been concluded in favour of a revised and expanded research programme. New studies will include the use of genetic pools of a wide variety of South African fynbos species.

GS.2431/30/2/1:

SEED REPRODUCTION OF PROTEAS. 1975-1985

G.J. Brits

Complete control over the germination of hybrid seed of *Leucospermum* cut flower species is required for breeding purposes. This work was undertaken to study the severe and complex seed dormancy of *Leucospermum cordifolium*, the primary cut flower species of the genus. Scarifying seeds with sulphuric acid and soaking in hydrogen peroxide solutions led to complete germination of intact viable seeds sown in seed beds during autumn.

It was shown that pericarp-imposed dormancy by means of oxygen exclusion is a characteristic of most nut-fruited Proteaceae ($10/14$ species of three genera tested) but not of serotinous species ($13/15$ species of three genera). Successful seed germination in *L. cordifolium* was found to be strongly dependent on moderately low seasonal air temperature. Low temperature requirement was found to be independent of oxygen requirement.

It was argued that this is not a "classical" stratification requirement. The low temperature requirements of *Leucospermum cordifolium* and *Serruria florida* seeds were shown to be of a diurnal nature, not seasonal. Diurnal high temperature was also required for maximal germination. Diurnal temperature requirements were estimated at 9 and 24 °C for the former and 7 and 20 °C for the latter species.

Some of the physiological work of Van Staden & Brown (1977) on seed germination of nut-fruited species were re-interpreted. A working eco-physiological model for seed germination in *L. cordifolium* was proposed.

Horticultural applications including full control over seed bed germination in *L. cordifolium* were developed.

Reference

VAN STADEN, J. & BROWN, N.A.C., 1977. Studies of the germination of South African Proteaceae - a review. *Seed Sci. and Technol.* 5, 633-643.

The length of the night break, required to prevent induction, increased as the natural dark period increased towards the middle of winter. A 1-h night break had no significant effect on the time of induction, while a 2- and 4-hour night break delayed the time of induction by approximately 3 and 6 weeks, respectively. A six-hour night break was the minimum length which could delay induction up to the termination of the experiment on the first of May, i.e. a 2-month delay.

POT PLANTS

• Physiology

GS.2432/03/1/2:

RAPID MULTIPLICATION OF BULB FLOWER POT PLANTS *IN VITRO*: *LAPEIROUSIA*.
1986-1987

E. Louw

A tissue culture technique for the rapid multiplication of *Lapeirousia silenoides* has been developed. Corms were used as explants. The corms were cut transversely into two halves, only the growth point of the upperhalf formed a shoot. After the first sterilisation 85 % of the corms were contaminated. The corms were re-sterilised and dipped into 0,2 % sodium hypochloride for 10 seconds before putting them on the medium again. This procedure resulted in only a 3 % contamination.

The basic medium that was used, was Murashige en Skoog with the micro-elements at half-strength and 25 mg dm⁻³ NaFeEDTA, 30 g dm⁻³ sucrose, 100 mg dm⁻³ myo-inositol, 0,5 mg dm⁻³ tiamine-HCl and 7 g dm⁻³ agar were added. The best shoot proliferation were obtained on a medium with 1 mg dm⁻³ BAP. For further proliferation it must be transferred to a medium with 0,1 mg dm⁻³ NAA and 1 mg dm⁻³ BAP. Rooting was best on a basic-medium with 1 mg dm⁻³ IBA. Cytokinines delayed corm development. The *in vitro* plantlet can be forced to develop corms by keeping it on the medium till the medium is exhausted.

CUT FLOWERS

• Pathology

GS.2433/19/2/1:

SHRUB-LIKE CUT FLOWERS: VIRUS DISEASES OF ROSES. 1963-1987

P.J. Klesser

This study was deemed necessary because:

- there was an increasing interest in including roses in commercial cut flower production;
- a great number of new cultivars was being imported; and
- there was such a complexity of diseases and disorders that a high percentage of trees became unthrifty or were killed within two to three years.

Considerable work was done on some problems before their causal organism had been correctly identified - this was due to a lack of published data and of collaborating colleagues. By the same force of circumstances very necessary horticultural aspects also had to be included in this project.

The top priorities were to find a suitable test plant/indicator for the rose viruses, and to develop a technique for indexing.

Eventually a clone of the rootstock Clarke 1957 was chosen as no seed species proved to be sufficiently sensitive.

Rose mosaic and yellow mosaic viruses are common and are easily transmitted by budding. Cut flower production can be reduced by 14 to 25 %.

Rose streak virus is rare - this was the first report outside the USA.

As the Rose Scheme developed, refinements were made to the indexing technique to allow simultaneous evaluation of new candidates. To date, 1099 cultivars have been rated.

Clonal selections are maintained of 28 rootstock types and 405 cultivars, in insect-proof screenhouses.

These are available to SANA members and the following have been sold:

- Rootstock cuttings 2 179 329
- Budded trees 2 636
- Budwood 96 198

Virus elimination by heat therapy has been successfully evolved and over 50 cultivars have been freed from the mosaic virus.

With the availability of virus-indexed material of both rootstocks and cultivars compatibility trials were started to investigate the so-called stock-scion effect. Results showed that very significant improvements were possible with the correct combinations.

The same material was used to establish display gardens.

A great number of virus-like symptoms were ascribed to the phytotoxicity of some spray chemicals or to their formulations. These included fungicides, insecticides, nematocides and herbicides.

Of the other diseases and disorders the most time was spent on the devastating die-back which attacked and killed certain cultivars. This was eventually identified as a vascular fungus, *Verticillium dahliae*.

The susceptibility of new cultivars to the common fungus diseases, Black spot and Mildew was monitored over many years. The level of *Cercospora* leaf spot on rootstocks was also recorded.

Physiological factors were proved to be the cause of two problems, viz. Black band and Stem canker. Both resulted in extensive die-back which impaired virus observations.

Pome and stone fruits

APPLES

• Physiology

VV.2441 03 3 2:

CHEMICAL THINNING OF APPLES. 1985-1988

A.F. Lourens

Chemical agents were evaluated as fruit thinning sprays on apples over a period of three years. Results from the first year's trial eliminated scorching agents because of an unacceptable increase in russetting with both Golden Delicious and Granny Smith cultivars. Sevin, at 60 g per 100 l of water sprayed on Granny Smith trees 18 days after full bloom with supplementary hand thinning to two fruits per cluster 6 weeks after full bloom, gave the best yields for all three consecutive years. The average fruit size compared well with that of the control (hand thinning to one fruit per cluster). This evidence supports this common farming practice to be the best method to thin Granny Smith apples.

With Golden Delicious apples the standard practice thinning sprays of Amid-Thin (70 g 100 l) with or without Promalin (65 m l 100 l), sprayed 2 days after full bloom with supplementary hand thinning, did not improve the average yields compared to the control over the three years and a definite reduction in average fruit size was recorded. The mixture of Planofix plus Promalin (25 m l + 65 m l 100 l), sprayed 18 days after full bloom with supplementary hand thinning, gave the same average fruit size than the control over the three-year period with an increase of more than 20% on the average yields in rands per hectare. This promising thinning spray should be evaluated in a commercial field trial.

VV.2441 03 6 8:

A STUDY OF THE MUDDY BROWN DISCOLOURATION OF STARKRIMSON APPLES.
1981-1988

C.F. Hansmann

The effect of fertilisation on the occurrence of the brown discolouration of Starkrimson apples was studied in a N x K x Mg factorial experiment.

Fertilisation apparently did not affect the incidence of the disorder. During the 1983/84 season significant differences were obtained after 2,5 and 4,5 months cold storage at $-0,5^{\circ}\text{C}$ in the case of the nitrogen treatments. During the 1985/86 season a significant nitrogen effect was only observed at harvest. No significant differences were observed during the 1982/83 season and only a significant N x Mg interaction during the 1984/85 season.

Analysis of anthocyanins and chlorophyll were also done on peel samples. However, very poor correlations were obtained between these values and the incidence of the discolouration.

It is assumed that other unidentified factors related to cultivation are the main cause of this discolouration.

• Nutrition

VV.2441 05 1 6:

INVESTIGATION AND REVISION OF METHODS OF CHEMICAL ANALYSIS OF SOIL AND PLANT SAMPLES FROM APPLE ORCHARDS. 1984-1988

H. Gerber

A number of routine analysis procedures were studied with regard to ease of operation and reliability of results. The methods involved were estimation of chloride in water and leaf samples, bicarbonate in water samples and cation exchange capacity of soil samples.

Published procedures for the estimation of chloride and bicarbonate by auto-titration with standard silver nitrate and hydrochloric acid, respectively, were evaluated. Excellent results were obtained and procedures were adapted for routine use in the FFTRI Analytical Unit.

Methods for the estimation of cation exchange capacity based on cation saturation and displacement in either buffered or unbuffered electrolyte solutions, measurement of Adams-Evans buffer pH values, isotopic dilution, sum of cations and adsorption of silver from relatively dilute solution were compared. The soils used in this study developed little variable change. However, in one soil the CEC value was increased three-fold by using Na-acetate at pH 8,2 as compared to NH_4Cl at field pH.

The Adams-Evans buffer method gave erratic results and tended to over-estimate CEC in a number of soils. In saline soils and soils with pH greater than 5,5 the sum of cations was not a good indication of CEC. CEC values obtained by isotopic dilution and with adsorption of silver from dilute Ag-thiourea compared well and these were considerably smaller than those obtained with NH_4Cl at field pH in almost all soils.

The high values obtained with the latter method might have been due to incomplete washing, but it could also have been caused by alteration of the soils' exchange characteristics by the high ionic strength of the equilibrating solution. Isotopic exchange is considered to be the best means of measuring thermodynamic equilibrium in cation exchange.

However, routine application of a tracer technique for estimation of CEC would result in unnecessary exposure of personnel to ionising radiation and could also create a problem with disposal of radio-active waste. Therefore, the Ag-thiourea method should give acceptable results for routine use and will in future be used by the FFTRI for the estimation of CEC in orchard soils.

• Upgrading

VV.2441 07 1 6:

IN VITRO MUTATION BREEDING OF GRANNY SMITH TO DEVELOP A COMPACT GROWTH HABIT. 1985-1987

R.E. Pieterse

Adventitious buds on leaves were successfully initiated in both Granny Smith and *Malus purpurea*, but the numbers that developed varied. One of the reasons for this was identified as the age of the mother population. Rooting on polyurethane foam gave good results provided the correct brand of foam was used.

In *M. purpurea* good development of the red leaf colour was obtained by raising the sucrose concentration of the medium. No mutation to a solid green bud occurred in irradiated shoot-tips of *M. purpurea*. A cross made between Granny Smith and *M. purpurea* showed that *M. purpurea* is heterozygous for the red leaf colour and that the character is polygenic.

No results were obtained from great populations of Granny Smith shoot tips irradiated for mutation breeding owing to constant interruptions. Vitrification and endogenous bacteria also slowed down the work.

• **Pests**

VV.2441/20/1/1:

RADIATION-STERILISATION OF THE INFESTING STAGES OF FRUIT FLIES ON APPLES.
1972-1988

B.N. Barnes

Deciduous fruit in South Africa is subject to infestation by two species of fruit flies, viz Mediterranean fruit fly, *Ceratitis capitata*, and Natal fruit fly, *Pterandrus rosa*. Both species are subject to quarantine regulations imposed by countries importing South African fruit. The current phytosanitary control of fruit fly in export deciduous fruit by transit low temperature sterilisation schedules is inadequate, as it is not possible to guarantee that all fruit arriving at its destination will be totally free from fruit fly infestation. Research under this facet was intended to investigate gamma radiation as a possible quarantine treatment for export deciduous fruit.

Quarantine security where a single radiation dose per age group is involved (as in this facet) is stipulated at 100 % mortality in at least 100 000 irradiated and viable individuals. Three age groups of pupae of the two fruit fly species were ultimately selected as the target developmental stage, viz 4, 5 and 6 days old. This was based on the estimation that under the conditions prevailing at the time of facet registration, the oldest pupa which could arrive at a harbour irradiator would be 5 days old. Four- and 6-day-old pupae were included to make allowance for possible deviations in packing and railing procedures.

After the irradiation of more than 1,75 million pupae of both species, the following doses of gamma radiation have been found to satisfy the above quarantine security requirements:

Species	Age	Radiation dose
<i>P. rosa</i>	4 days	0,25 kGy
	5 days	0,35 kGy
	6 days	0,45 kGy
<i>C. capitata</i>	4 days	0,35 kGy
	5 days	0,55 kGy
	6 days	0,65 kGy

It is therefore concluded that it is technically possible to prevent adult emergence from pupae of both *P. rosa* and *C. capitata* which may occur in packed export deciduous fruit, by gamma radiation. Effective doses applying to both species of fruit fly between pupal ages of 4 and 6 days old are between 0,35 and 0,65 kGy, depending on the age of the pupae which may occur in the packed cartons (in other words, the time elapsed between fruit-packing and irradiation).

These doses are below radiation levels at which pome and stone fruits are reported to be damaged by radiation (1,0-1,5 kGy). However, practical considerations surrounding the decentralisation of deciduous fruit palletisation and cold-chain initiation will influence to a considerable extent the feasibility of insect disinfestation of export fruit by radiation.

• **Crop science**

VV.2441/30/1/4:

HORTICULTURAL COMPARISON OF EIGHTEEN GOLDEN DELICIOUS APPLE TYPES.
1979-1988

P.R. Jolly

Eighteen cultivars of Golden Delicious clones were evaluated of which twelve were standard Golden Delicious types, three were Golden Delicious spur types and three were non-Golden Delicious types. The three standard types, viz Smoothee FFTRI virus-free Golden Delicious and Golden Delicious EMLA as well as the non-Golden Delicious type Jonagold were released to the industry.

All the spur types performed poorly owing to either very yellow fruit or low levels of production. Six of the standard types also had low levels of production owing to virus infection.

The remaining six standard Golden Delicious types namely Smoothee, FFTRI Golden Delicious clone, Golden Delicious EMLA, Golden Delicious A50 clone, Golden Delicious B50 clone and Golden Delicious 14.1.1 clone, performed well with regard to crop levels. Both stem-end and calyx-end russetting occurred on fruit of these clones. Results of the past five years showed that Smoothee had the lowest incidence of calyx-end russet while Golden Delicious 14.1.1 clone had the lowest incidence of stem-end russet. Crop levels of these clones did not differ significantly during the past five years. Smoothee, however, could be spaced closer in orchards and could give better yields.

• *Technology*

VV.2441/52/1/3:

EFFECT OF RATE OF RE-COOLING AND ATMOSPHERE MODIFICATION ON APPLE
QUALITY. 1984-1988

Sandra J. van Eeden

Golden Delicious, Starking and Granny Smith apples were used to determine the effect of cooling rate, re-cooling and the rate at which controlled-atmosphere (CA) conditions were established on the quality of fruit after storage.

Apples were cooled to $-0,5^{\circ}\text{C}$ within 48 h by means of forced-air cooling and kept at $-0,5^{\circ}\text{C}$ for 10 days, whereafter fruit were transferred to 20°C and packed after 12 h at 20°C . Fruit were re-cooled to $-0,5^{\circ}\text{C}$ over periods of 4, 8, 12, 16 and 20 days. Apples were also packed directly and cooled to $-0,4^{\circ}\text{C}$ over periods of 4, 8, 12, 16 and 20 days and stored under regular atmosphere (RA) conditions for 3 months, after which quality was determined in terms of firmness and colour. For CA storage fruit were cooled to $-0,5^{\circ}\text{C}$ over periods of 48 h and 72 h and CA conditions established over 3, 6, 9, 12 and 15 days.

Golden Delicious apples must be cooled to $-0,5^{\circ}\text{C}$ within 4 days after harvest, Starking within 8 days and Granny Smith within 12 days for RA storage. If apples destined for CA storage were cooled to $-0,5^{\circ}\text{C}$ within 72 h the rate at which CA conditions was established was not critical provided it did not exceed 6 days.

PEARS

• *Technology*

VV.2442/52/1/2:

EFFECT OF RATE OF RE-COOLING AND ATMOSPHERE MODIFICATION ON PEAR
FRUIT QUALITY. 1984-1988

Sandra J. van Eeden

Bon Chretien and Packham's Triumph pears were used to determine the effect of cooling rate, re-cooling and the rate at which controlled-atmosphere (CA) conditions were established on the quality of fruit after storage.

Pears were cooled to $-0,5^{\circ}\text{C}$ within 48 h by means of forced-air cooling and kept at $-0,5^{\circ}\text{C}$ for 10 days, whereafter fruit were transferred to 20°C and packed after 12 h at 20°C . Fruit were re-cooled to $-0,5^{\circ}\text{C}$ over periods of 2, 4, 8 and 12 days and 4, 8, 12, 16 and 20 days for Bon Chretien and Packham's Triumph, respectively.

Pears were also packed directly and cooled to $-0,5^{\circ}\text{C}$ over periods of 2, 4, 8 and 12 days for Bon Chretien, and 4, 8, 12, 16 and 20 days for Packham's Triumph and stored under regular atmosphere (RA) conditions for three months, after which fruit quality was determined in terms of firmness, colour and incidence of scald development. For CA storage fruit were cooled to $-0,5^{\circ}\text{C}$ over periods of 48 h and 72 h and CA conditions established over 3, 6, 9, 12 and 15 days.

Bon Chretien pears had to be cooled to $-0,5^{\circ}\text{C}$ within 2 days after harvest and Packham's Triumph within 4 days for RA storage. Increases in temperature necessitating re-cooling must be avoided. Bon Chretien pears destined for CA storage must be cooled to $-0,5^{\circ}\text{C}$ within 48 h and Packham's Triumph within 48 h to 72 h. If pears were cooled within 48 h, the rate at which CA conditions was established was not critical, provided it did not exceed 6 days.

PEACHES

• *Physiology*

VV.2443/03/4/5:

MATURITY INDICES FOR CLINGSTONE PEACHES FOR FRESH MARKETING. 1986-1988

T.R. Visagie

During the past three seasons research work was done to determine a reliable and practical maturity index for clingstone peach cultivars destined for the fresh market. The cultivars Malherbe, Neethling and Kakamas

were harvested at different stages of maturity and stored at $-0,5^{\circ}\text{C}$ for four weeks. Fruit firmness was determined by means of a penetrometer with an 11-mm point, and changes in colour, sugar content (TSS), taste, keeping quality and loss in mass were recorded.

Results indicated that external colour, as currently used, was the only reliable and practical criterium. Clingstone peach cultivars are harvested at the green-yellow (i.e. more yellow than green) to yellow colour stage and this proved to be the only practical indication of picking maturity.

Measuring the firmness and TSS (sugar content) was a poor indication of picking maturity. Differences in firmness and TSS (sugar content) between green and ripe fruit were too small to be used as a reliable and practical indication of the correct stage of maturity. Results also indicated that there were no differences in loss of mass between cultivars. The peaches lost approximately 5 % mass during storage at $-0,5^{\circ}\text{C}$ but mass increased to about 8,5 % during the marketing period.

● *Crop science*

VV.2443/30/4/1:

EFFICIENCY AND PHYTOTOXICITY OF HERBICIDES WHEN USED WITH PEACHES.
1984-1988

A.F. Lourens

A variety of problem areas in weed control in peaches (and some other crops) were studied. Phytotoxicity of registered herbicides, lack of relative safe and/or economic weed control programmes and efficient control of problem (resistant) weeds were the major areas studied.

The relative phytotoxicity of registered and other herbicides applied as a soil drench to young peach seedlings in sand cultures were evaluated and typical symptoms were recorded. The effect of different amounts of irrigation directly after pre-emergence herbicide application was studied with a rainfall simulator and it was found that an optimum amount of irrigation can improve the weed control of some herbicides.

Spray drift of systemic herbicides were studied in a wind tunnel and it was found that the use of low pressure nozzles minimised this phenomenon.

The effect of different types of additives with a grass killer was evaluated and was found that oil-based additives improved control. Grass killers were evaluated on bermuda grass control in a field trial and glyphosate formulations gave the only acceptable control.

Some herbicides, including growth regulators, were evaluated for nutsedge control in a potted trial. Metolachlor showed promising results and this is significant because it proved to be relative safe to young peach seedlings.

● *Water requirements*

VV.2443/31/1/1:

LYSIMETER STUDIES ON IRRIGATION SCHEDULING WITH PEACHES. 1979-1988

H. Tormann

Independence nectarine trees were planted in free-drainage lysimeters and received differential irrigation, starting the third year after planting. Soil water content was measured twice weekly by means of a neutron moisture meter. Soil water was easily available to the trees between field water capacity (240 mm m^{-1}) and a soil water content of 165 mm m^{-1} . Water uptake was reduced at a soil water content of less than 165 mm m^{-1} which was equal to a soil matric potential of -100 kPa in this experiment.

Mid-day temperature of the foliage was measured by means of an infra-red thermometer. A water stress index and the canopy temperature difference between the dry and wet treatment (CTD dry-wet) were calculated from the measurements. These parameters were not effected by ambient temperature and humidity and closely related to the plant water potential measured simultaneously. CTD dry-wet was $1,3^{\circ}\text{C}$ and $3,2^{\circ}\text{C}$ when the plant water potential was $-1,5\text{ MPa}$ and $-2,3\text{ MPa}$, respectively.

Only small differences in crop yield and vegetative growth of the Independence nectarines were found between treatments, mainly as a result of the very low fruit set following severe delayed foliation.

PLUMS

• Physiology

VV.2444 03/1/1:

DEVELOPMENT OF A TECHNIQUE TO REGENERATE PLUM PLANTS FROM PROTOPLASTS. 1982-1988

P.W. Vermeulen

The report deals with the development of an optimal medium for callus initiation on stem explants from *Prunus salicina* Lndl. cv. Harry Pickstone.

Stem explants sealed in containers with Belco caps or foil and incubated in the dark produced the most callus. The substances to be tested for the optimal medium were varied while all other components were kept constant. The optimal medium established contained the basic salt nutrients of Gamborg & Wetter (Bs) supplemented with 15 g dm⁻³ sucrose; 0,5 mg dm⁻³ each of thiamine, pyridoxine and nicotinic acid; 1 mg dm⁻³ riboflavin; 500 mg dm⁻³ myoinositol; 20 mg dm⁻³ casein hydrolysate; 30 mg dm⁻³ chlorogenic acid; 0,128 mg dm⁻³ each of 2,4-D and BA; 20 mg dm⁻³ thiourea and 1,5 g dm⁻³ "Gelrite". The provision of an anti-oxidant to prevent polyphenolic browning of explants were very important.

These results obtained were not the global aim of the study, but is one of the fundamentals on which further study would be based. It is important, especially in unknown woody species, to first establish a medium for the production of callus, before protoplast studies will be attempted.

The next step would be the development of a technique for the culturing of protoplasts.

VV.2444/03/4/1:

RELATIONSHIP BETWEEN ORCHARD TEMPERATURE, FRUIT SIZE, NUTRIENT UPTAKE AND INTERNAL BREAKDOWN OF PLUMS. 1983-1988

H. Tormann

Field observations have indicated that temperature has an effect on internal breakdown of plums. It was not possible, however, to induce internal breakdown in Harry Pickstone plums by different day/night temperature regimes during a 4-week period just after full bloom and prior to picking.

Foliar sprays of Songold plums with chemicals such as gibberellins, calcium, phosphates and Promalin had no beneficial effect on internal breakdown.

Treatment of fruit prior to storage with Semperfresh, a wax formulation, delayed ripening but had no effect on internal breakdown in three plum cultivars.

Internal ethylene content of plums increases with picking maturity of plums and is associated with internal breakdown. Santa Rosa plums with a very low internal ethylene content at picking date developed internal breakdown, while Songold plums with a relatively high internal ethylene content developed gel-breakdown (over-ripeness) after storage. Harry Pickstone plums were sound after storage, even though the fruit differed in ethylene content on picking date.

Laetitia and Casselman picked with a firmness of 6,8 kg and 5,4 kg, respectively, had good taste, were attractive and sound after cold storage and this firmness is recommended as picking maturity standard.

• Pathology

VV.2444/19/1/6:

LATENT BLOSSOM BLIGHT/BROWN ROT INFECTIONS ON PLUMS. 1986-1988

Helen E. Schlagbauer

A study was made of the occurrence of latent or quiescent *Monilinia laxa* infections on plums, peaches and apricots. Penetration of plums and the histology of small necrotic lesions detected on immature inoculated fruit, were investigated by light and scanning electron microscopy (SEM). SEM was further used to study infection of plum blossoms inoculated with *Monilinia laxa*. Consideration was also given to survival of the fungus in different parts of flowers.

Short-term latent infections occurred frequently on apricots (5,3 %) and peaches (3,1 %) during the 1985/86 season. The incidence of latent infections on plums during two consecutive seasons were extremely low (0,9 % in 1985/86; 1,2 % in 1986/87).

No evidence was found to indicate that immature or hard- and full-ripe plums are penetrated directly or through stomata. The pathogen entered full-ripe fruit through cracks in the cuticle next to the stomata.

Small pin-point lesions which resembled defence reactions, were present on immature and hard-ripe plums after inoculation. No clear evidence of the presence of fungal material could be found in these lesions.

M. laxa entered plum blossoms directly via the filaments and sepals. No clear evidence was found of penetration of petals, stigmas or styles. Sporulation was detected on stamens, sepals and calyx cups, but not on stigmas or styles.

Long-term latent infections do not seem to contribute to fruit losses at harvest. Owing to the possible devastating effect of *M. laxa* on blossoms and the susceptibility of ripe fruit, proper disease management practices before and during blossom, and on mature fruit have to be emphasised to growers.

VV.2444/19/2/4:

ETIOLOGY OF BACTERIAL CANKER OF PLUMS. 1985-1987

Isabel M.M. Roos

The results indicated that appearance of symptoms on cherry inoculated in spring with virulent strains of *Pseudomonas syringae* pv. *morsprunorum* depended on the inoculation method. Water-soaked veins and lesions developed on leaves wounded by rubbing during inoculation. At higher inoculum concentrations, more lesions appeared. No lesions developed on leaves sprayed until run-off unless water-soaking had occurred. However, the pathogen was seen in symptomless leaf blade and petiole tissue, regardless of the inoculation method applied. Expression of disease symptoms during the next spring implied that the pathogen had also spread systemically to shoots and axillary buds. *P. syringae* pv. *morsprunorum* introduced by spraying probably gained entry into leaf tissue through stomata and then spread intercellularly from the mesophyll through the parenchyma of the bundle sheath into the vascular system of minor veins. Once the veins had been invaded, migration occurred to other regions in the leaf blade and petiole.

Cherry blossoms inoculated with *P. syringae* pv. *morsprunorum* died or gave rise to fruits containing spots at or near the distal ends. SEM indicated that the pathogen had invaded the entire pericarp, including the endocarp. It also spread to the fruit stalk, and, to a lesser extent, to the spurs. Mesocarp cells below the lesion collapsed. This is the first report of systemic spread of *P. syringae* from blossoms to developing fruit of a deciduous crop.

P. syringae pv. *syringae* infiltrated into petioles of plum trees preferentially colonised the xylem elements. The pathogen probably spread systemically to the xylem of the major and minor leaf veins and also to shoots without causing visible symptoms. Micro-colonies were seen on the surfaces of these leaves, indicating that systemic invasion of host tissue enables the pathogen to replenish to epiphytic populations.

• Crop science

VV.2444/30/2/2:

PHASE-2 EVALUATION OF LOCALLY BRED PLUM ROOTSTOCKS. 1980-1988

J.H. Acker

Three different experiments were carried out. For all three experiments yield and trunk circumference data were collected for four consecutive seasons. Yield efficiency was calculated at the ratio between yield and trunk circumference in two experiments and yield and trunk area in one experiment. The data was analysed statistically and for two experiments Gupta's multi-variable t-test procedure was used to select the best group of rootstocks.

Experiment A

Virus-free Gaviota was compared with virus-infected Gaviota on seven locally bred, clonal plum rootstock selections.

Trees were free-standing and trained to an open vase shape. Virus-free Gaviota was significantly better than virus-infected Gaviota with respect to yield and yield efficiency. Trunk area did not differ significantly. The seven rootstock selections 6-64, 6-13, 7-7, 12-55, 12-64, 6-63 and 6-57 could all be selected for at least one parameter. Since the experiment unfortunately did not include a rootstock control, the performance of the selections relative to standard rootstocks could not be determined.

Experiment B

Two semi-dwarfing, locally bred plum rootstock selections, 8-6 and 9-52, were compared with virus-free Marianna at three different planting densities. Reubennel served as scion cultivar and trees were trained to a

palmette system. The widest spacing (4,5 x 2,75 m) and the narrowest spacing (3,5 x 1,75 m) differed significantly with respect to all three parameters. The widest spacing produced the lowest yield per plot, the lowest average trunk circumference per plot and the highest yield efficiency. With regard to the selection's performance, selection 8-6 was more dwarfing than Marianna but otherwise did not differ from it. Selection 9-52 produced a significantly lower yield than Marianna but did not differ with respect to yield efficiency, however, it was more dwarfing than Marianna. Selection 8-6 was therefore the better of the two rootstocks although none of them performed better than Marianna.

Experiment C

Nine locally bred, clonal rootstock selections, 6-46, 6-59, 9-36, 9-41, 9-52, 9-63, 11-37, 11-61 and 8-6 were compared with virus-free Marianna. Songold served as scion cultivar. Trees were trained to an open vase shape. The only two clones that could be selected for all three parameters were selections 8-6 and 9-52. Two other selections, 9-63 and 6-59, were as vigorous as Marianna. Although these two selections did not differ significantly from Marianna with respect to yield and yield efficiency, their real values were higher. They, therefore, justify further evaluation. Since there are indications of rootstock/scion interaction, a further evaluation of these rootstocks with more cultivars is recommended. Particularly 8-6 and 9-52 are promising and leave scope for yield increase by means of plant density manipulation.

APRICOTS

• Physiology

VV.2445/03/4/1:

DETERMINATION OF RELIABLE MATURITY INDICES FOR APRICOTS. 1983-1988
T.R. Visagie

During the past four seasons research work was done to determine a reliable and practical maturity index for certain commercial apricot cultivars. The cultivars Palsteyn, Bulida, Peeka and Royal were harvested at different stages of maturity and stored at -0,5 °C. Palsteyn, Peeka and Royal were stored for 4 weeks at -0,5 °C while Bulida was stored for 1 week at -0,5 °C. Bulida has a poor keeping quality but export by air makes it possible to market this cultivar in a good condition overseas. Firmness measurement by means of a penetrometer, change in colour, pH, acid and sugar content (TSS), variation within and between trees, injuries occurring between harvesting and packing and loss of mass were investigated.

Results indicated that penetrometer readings together with colour was the only reliable and practical criterium. Firmness of a sample consisting of 20 to 30 fruits is measured and harvesting is then done according to the colour of the fruit corresponding with the optimum firmness. Colour can vary from season to season and therefore firmness readings must be taken to indicate to the picker at what stage he should pick. The optimum stage of maturity for the present apricot cultivars are 5,5 kg to 8,2 kg measured with a penetrometer with an 11-mm point.

pH, acid and sugar content proved to be poor criteria of picking maturity. These parameters can be a good index of quality but not of picking maturity. A minimum TSS value together with penetrometer readings can be significant to the producer. A minimum TSS of 12% is therefore recommended.

During the picking and packing process injuries in the form of bruises and rub marks occurred at random and sporadically. Careful handling is essential in the successful marketing of apricots. There is a 5% loss in mass from harvesting until the fruit reach the consumer.

• Upgrading

VV.2445/07/1/6:

IN VITRO MUTATION BREEDING OF ROYAL APRICOT TO DEVELOP BETTER
RESISTANCE AGAINST *PSEUDOMONAS* AND/OR *XANTHOMONAS*. 1985-1987
R.E. Pieterse

Shoot tip cultures of Royal, Bulida (canino), Super Gold, Soldonne (apricots), Independence, Olympia (nectarines) and *Prunus cerasifera* and callus cultures of Olympia and Royal stem tissue and Royal embryos were successfully initiated. Great numbers of secondary embryos developed *in vitro* on Royal embryos of different ages.

No experiments could be finalised owing to constant interruptions of the work and the termination of the facet.

CHERRIES

- *Crop science*

VV.2446/30/1/2:

EVALUATION OF CHERRY ROOTSTOCKS FOR THE EASTERN FREE STATE. 1975-1988
K.G. Zwahlen

Considering that no yield control by means of pruning or thinning of fruit is practical with cherries, alternating yields must be expected, especially with sweet cherries on Mahaleb, the only rootstock used in the Eastern Free State.

In this trial Mahaleb was compared with Mahaleb B40, Mazzard F12/1 and Stockton Morello. The most important sweet cherries Black Tartarian, Bing, Heidelfinger and Napoleon, were tested on these rootstocks.

Results proved that sweet cherries on Mazzard F12/1 produced a crop only after seven years but from then on the production is more constant and higher. After 9 cropping seasons 8,3 ton/ha/year was obtained with the different sweet cherry cultivars, an increase of 83,3 % against trees on Mahaleb.

Trees on Stockton Morello bear crops earlier and produce higher yields at an earlier stage than trees on Mazzard F12/1 and Mahaleb. After 9 cropping seasons 7,6 ton/ha/year was obtained; an increase of 67,2 % against trees on Mahaleb.

The yield on Mahaleb is lower and more variable. After 9 cropping seasons 4,5 ton/ha/year was obtained. It is clear that with Mahaleb more root problems on shallower Clovelly/Avalon soils are experienced which result in poorer growth and fruit set.

Mahaleb B40 corresponds with Mahaleb to a great extent as far as growth and production (5,0 ton/ha/year) is concerned. There is, however, an indication that Mahaleb B40 has a better affinity with the scion. The production increase against Mahaleb was 11,3 %. The results indicate that the production of the Bing cherry on Mahaleb was exceptionally lower (more than 125 %) than on Mazzard F12/1 and Stockton Morello.

It is clear that Mazzard F12/1 and Stockton Morello are better rootstocks for cherries under Eastern Free State conditions and the use of these rootstocks can improve conditions in the cherry industry substantially.

The above information is included in the leaflet series of the Directorate Agricultural Information.

Berry fruits

BERRIES

- *Technology*

VV.2451/52/1/1:

BERRIES: POST-HARVEST HANDLING OF STRAWBERRIES. 1984-1988
A.B. Truter

Strawberries were subjected to different post-harvest treatments to determine if export by sea was possible. In a controlled-atmosphere consisting of 4 % oxygen + 6 % carbon dioxide and at temperature of -0,5 °C, strawberries maintained a satisfactory quality for 3 weeks and had a 2-day shelf-life at 20 °C subsequently. This makes export by sea possible, but at present no controlled-atmosphere facilities are available on ships. Methods to maintain quality of strawberries during air export were then investigated.

Wrapping of punnets containing strawberries with a suitable wrapping material was essential to create modified atmosphere conditions inside punnets. This had a beneficial effect on the keeping quality of the strawberries. A carbon dioxide treatment of 25 % or 30 % applied for one day prior to storage at 5 °C also improved the shelf-life and maintained fruit quality. Irradiation on the day of harvest was very successful in

maintaining the quality of fruit. For local marketing it is a very promising treatment and producers are encouraged to make use of this treatment.

Rapid cooling of strawberries after picking and packing to a temperature of 4.5-5.0 °C was very successful and just as good or even better than the other treatments. Strawberries for air export should be cooled directly after packing and kept at the low temperature until the next day. During air transport the temperature will be approximately 15 °C. Under these conditions fruit can be kept in an excellent condition for at least four days which allow for orderly marketing.

Viticulture

TABLE GRAPES

• Physiology

WW.2461 03 1 2:

THE EFFECT OF TWO PLANT GROWTH REGULATORS ON THE CHARACTERISTICS OF WALTHAM CROSS AND SULTANINA TABLE GRAPES. 1985-1988

G.N. Wagener

The aim of this study was to determine the effect of an auxin and an ethylene suppressing substance, on certain bunch characteristics of Sultanina and Waltham Cross.

In a preliminary trial during 1983, fourteen plant growth regulator treatments, as well as girdling, were applied in a Sultanina vineyard at Lutzville, in an endeavour to find indications of how to control loose berries. Although no treatment was able to control loose berries significantly, girdling and the plant growth regulators amino-oxy-acetic acid (AOA) and 2,4,5-trichloro-phenoxy propionic acid (2,4,5-TP) showed some promise.

During the 1984 and 1985 season, the effect of these two plant growth regulators on the occurrence of loose berries, ripening, respiration, ethylene formation and storage qualities of Waltham Cross and Sultanina grapes, were studied.

For both cultivars there was a tendency towards more loose berries with longer cold storage periods. The 1985 season induced more loose berries than the previous season, indicating an effect of climate. Both 2,4,5-TP and AOA reduced loose berries but were found to be cultivar specific. For Sultanina, AOA was the most effective of the two growth regulators, whereas 2,4,5-TP induced better results in the case of Waltham Cross. However, for both seasons and cultivars, both auxins, but especially 2,4,5-TP, had a negative effect on the keeping abilities of the grapes under cold storage.

Both AOA and 2,4,5-TP had no effect on the mass or size of Waltham Cross berries, but 2,4,5-TP induced larger berries in the case of Sultanina during 1985. No effect on berry shape was recorded but 2,4,5-TP tended to retard the ripening of Sultanina.

Measurements of respiration rate showed that respiration levels off after 30 minutes, thus allowing considerably less measurements to be made. No clear relationship between respiration rate and loose berries could be determined. As expected, respiration rate tended to slow down for both cultivars from after véraison to harvest. However, a tendency towards an increase in respiration rate at the end of the cold storage period was observed for Sultanina. This is contradictory to results reported in literature.

The ethylene extraction method of Weaver & Singh was initially used but proved to be unsuccessful. Other extraction methods and larger samples were tried, as well as adaptations to the gas chromatographic procedures, but no ethylene could be detected.

Although 2,4,5-TP and AOA had a significant positive effect on loose berries in most cases, these growth regulators cannot be recommended in practice because of their detrimental side-effects as far as keeping qualities were concerned.

• Pests

WW.2461 20/1/1:

THE INCIDENCE AND IMPORTANCE OF THRIPS ON TABLE GRAPES. 1983-1986

A. Schwartz

A survey on table grape cultivars in the Paarl area and the Hex River Valley has shown that numerous thrip species occur on the bunches with *Thrips tabaci* Lindeman being the most abundant. *T. tabaci* is also

responsible for the damage on berries. On the leaves as many as eight different species of thrips were identified of which *Heliothrips sylvanus* Faure and *T. tabaci* are important.

T. tabaci has rasping mouthparts by means of which the outer skin layer of the young berry is damaged. The most common symptom is lesioning which originates as a ring at the pedicel attachment to the berry and stretches over the shoulder of the berry. It is characteristic of *T. tabaci* to start feeding at the flower base, as soon as the calyptra (cap) starts parting. At this stage no damage is discernable, but as the berry grows, so does the symptom. Different symptom patterns can be identified on berries of the same bunch. The infestation of berries is of short duration, lasting from one to two weeks.

This study has shown that damage to bunches is very sporadic and rare; thrips are therefore considered not to be of economic importance at this stage.

On leaves *H. sylvanus* has been found from October; the population increases to reach maximum numbers during March-April. This species causes distinct areas with a silver hue on the ventral and occasionally on the upper surface of leaves. Infestations can be unevenly distributed in a vineyard. Recordings of 38 %, 75 % and 100 % damage of mature leaves in samples did not result in premature leaf drop. The significance of such damage with regard to future vegetative growth and crop has not been determined.

It can be expected that the *T. tabaci* population will peak whenever growth cycles occur, i.e. October to December and or February to March, as this species prefers to feed on young succulent leaves. So far no significant damage to leaves in vineyards has occurred, although *T. tabaci* is a problem in nurseries.

Several natural enemies occur in association with the important thrip species on vines, i.e. the insect families Reduviidae and Chrysopidae and the mite family Phytoseiidae. The predaceous mite *Amblyseius addoensis* van der Merwe & Ryke appear to be the most important of the available predators and are abundant on the leaves from January to June. They overwinter in the buds on shoots.

WINE GRAPES

• Nutrition

WW.2462/05/1/2:

THE NPK REQUIREMENT OF WINE-GRAPES: STELLENBOSCH. 1972-1988
W.J. Conradie

Nature and scope

The effect of N, P and K fertilisation was determined in a 3 x 3 x 3 factorial trial, with Chenin blanc as test material, over a period of 12 years. Each treatment was replicated four times. The three levels of N amounted to 16 (N_0), 56 (N_1) and 96 (N_2) kg/ha while P applications were 0 (P_0), 9 (P_1) and 18 (P_2) kg/ha/a and K came to 0 (K_0), 45 (K_1) and 90 (K_2) kg/ha/a.

Results and discussion

Over the investigation period the pH in the topsoil of the N_2 treatments was reduced by 0,5 units in comparison with N_0 , illustrating the acidifying effect of nitrogenous fertilisers. Apart from this the grape yield of the N_2 treatment was increased on average by only 5,6 % compared to that of N_0 , suggesting that the N supplying capacity of this soil which contained 2 000 kg of organic N per ha down to a depth of 300 mm, was nearly sufficient to satisfy the demand of the grapevines. The N_1 treatment increased shoot mass by mass by 13 %, pointing to the stimulation of unnecessary vegetative growth, and it is suggested that an annual application of 40 kg N/ha was sufficient for the production of quality wines.

In the case of P the initial level in the topsoil amounted to 12,7 mg/kg and in the case of P_0 this was reduced to 8,4 mg/kg after 11 years while P_1 and P_2 were increased to 25,0 and 45,5 mg/kg, respectively. Grape yields and shoot masses of the P_1 treatment showed increases of 6 % and 13 % respectively while P_2 showed a lower response. The latter fact could have been due to a P-K antagonism. On this soil little fixation of P appeared to have occurred and an annual application of 0,4 kg/t of grapes produced should be sufficient to maintain existing levels.

The initial K level in the topsoil amounted to 38 mg/kg (K:CEC ratio of 4,6 %) and in the case of K_0 this was reduced to 28 mg/kg after 11 years. For K_1 and K_2 the contents were increased to 54 and 79 mg/kg,

respectively which amounted to K/CEC ratio's of 6,1 % and 7,9 %, respectively. The grape yield of K_1 was increased by 6,1 % over the control and no further response was found for K_2 .

In the case of N, fertilisation caused only marginal increases in the N contents of both blades and petioles. For must, however, the total N content of the N_2 treatment was 50 mg/l higher than that of N_0 . No consistent effect of N fertilisation on either grape or wine quality could be detected but during some seasons the occurrence of botrytis was enhanced by the highest N applications.

The application of P fertiliser caused appreciable increases in the P levels of both blades and petioles as well as in the must. At véraison the deficiency level for P in the petiole appeared to be around 0,08 %. Furthermore, the K content in both blades and petioles of the P_2 treatment was reduced, again pointing to a P/K antagonism. Apart from this, P fertilisation had little effect on either grape or wine quality.

The K levels in blades, petioles and must of the K_1 treatment were increased significantly over that of K_0 while K_2 caused a further increase in K contents of blades and petioles but not of the must. In addition to this K fertilisation also tended to reduce the N levels of the must. Both acidity and pH of the must from the K_1 treatment was increased in comparison with that from K_0 , while little further response was found for K_2 . During some seasons grapes from the K_2 treatment showed a smaller incidence of botrytis than grapes from the K_0 treatment.

• Pests

WW.2462/20/1/3:

DEVELOPMENT OF TECHNIQUES TO DETERMINE THE RESISTANCE OF WINE GRAPE ROOTSTOCKS TO ROOT-KNOT NEMATODES. 1980-1987

J.T. Loubser

Resistance of grapevine rootstocks to root-knot nematodes (*Meloidogyne* spp.) was studied in field trials. It was shown that susceptibility is adequately expressed by the degree of galling recorded over a two-year period in a nursery planting. A total of 53 rootstock cultivars and crosses were evaluated and 8 were found to be resistant, 20 moderately resistant, 14 moderately susceptible and 9 susceptible. It was further determined that a susceptible top scion does not have an effect on the resistance of the rootstock.

The experiments were done in more than one locality and the consistency of results is an indication of the reliability of the method used.

WW.2462/20/2/5:

BIOLOGY OF LEAFHOPPERS OCCURRING ON WINE GRAPES. 1982-1987

E. Marais

The leafhopper, *Acia lineatifrons* (Naudé) was identified as a pest on grapevines near Tulbach in 1978 and has since been reported on grapevines all over the South-western Cape. *A. lineatifrons* causes browning of the leaves which often results in the shedding of the discoloured leaves. Heavy defoliation before harvest can result in sunburn damage to the grapes, whilst premature leaf loss after harvest adversely affects the ripening of the canes and the accumulation of reserves.

This project was aimed at obtaining basic information on the biology and population dynamics of *A. lineatifrons* as well as to identify priorities for future research. This information is needed to develop a reliable crop-linked predictive model, methods for monitoring pest populations as well as to develop efficient short- and long-term control measures and pest management strategies.

The life cycle of *A. lineatifrons* was studied in the laboratory. At 26 °C the mean incubation period of the eggs was nine to eleven days, the mean developmental period for the five nymphal instars was 15 days and the minimum pre-oviposition period five to ten days. This adds up to a mean generation time of 29 to 36 days at 26 °C. At 20 °C the mean nymphal development period was 25 days, confirming the strong influence of temperature on the development rate. Fecundity was determined in the laboratory as the number of nymphs produced per female. The mean of 8,5 nymphs per female recorded at 26 °C is very low compared to that of other leafhopper species. The low fecundity measured was most likely due to sub-optimal environmental conditions in the laboratory, a reduction in the suitability of the host plant under these conditions and handling of the females.

The seasonal occurrence of *A. lineatifrons* on grapevines was studied over three seasons. It was found that the leafhoppers overwinter in the adult stage on indigenous *Rubus* spp., and that they enter the vineyard from the end of October until the beginning of November. Peak populations occurred between the middle of February and the end of March after which the population declined steadily towards the end of the season as the vine leaves were shed. The sex ratio of the overwintering population on *R. chrysocarpus* was heavily

female biased, possibly owing to differential mortality of the sexes. During the growing season the sex ratio was slightly male biased and reached equality on several occasions, both on the *Rubus* and on the grapevines.

The movement of *A. lineatifrons* between the *Rubus* and the grapevines was investigated, but no evidence of a directional migration from the *Rubus* to the grapevines was found. Furthermore, no evidence was found to indicate that morphologically distinct short- and long-distance fliers, as found in *Cicadulina* species by Rose (1972b), exist in the *A. lineatifrons* population. Host preference tests also showed that adult leafhoppers apparently have no significant preference for grapevines to *Rubus* or *vice versa*. It seems, therefore, that the leafhoppers' move onto the grapevines at the beginning of the growing season is not prompted by a host preference.

Chaboussou (1971) suggested that certain organic fungicides may cause leafhopper outbreaks because they affect the suitability of the vines as host plants and alter leafhopper fecundity. The effect of Mikal-M (active ingredient fosetyl-Al/mancozeb), a systemic dithiocarbamate fungicide, on *A. lineatifrons* was investigated. Laboratory experiments showed no significant effect on fecundity and leaf analysis of potted vines treated with Mikal-M indicated no significant difference in total leaf nitrogen compared to untreated control plants. However, the field experiment on the effect of Mikal-M on the population build-up of the leafhopper showed that significantly more leafhoppers occurred on the vines treated with Mikal-M than on those treated with a conventional inorganic fungicide, copper oxychloride. In view of the far-reaching implications this can have on the viticultural industry, further research on the effects of organic fungicides on leafhopper populations is recommended to confirm the generality of these results so that recommendations regarding the use of these fungicides may be made.

The question as to why *A. lineatifrons* became a pest was only recently raised. Three possibilities were considered, namely:

1. *A. lineatifrons* is a species of tropical origin which moved down the continent and became established in the Western Cape only recently.
 2. It has been in the Western Cape at least as long as the grapevines, but required prolonged exposure to establish itself on the new host.
 3. It has been on the vines for some time, but was noticed only recently when outbreaks occurred.
- These outbreaks could have been caused by the introduction of organic fungicides or the depletion of natural enemies by insecticides used to control other insects in the vineyards. Owing to the lack of evidence this question could not be answered conclusively.

Other research priorities that were established are the development of methods for damage assessment and monitoring of leafhopper populations, determining if *A. lineatifrons* can transmit grapevine viruses, the development of an economic threshold level and the identification of natural enemies of *A. lineatifrons* to enable the development of efficient pest management strategies.

WW.2462/20/2/6:

PEST MANAGEMENT: DEVELOPMENT OF A TRUNK BAND FOR THE CONTROL OF PESTS ON VINEYARD. 1983-1986

A. Schwartz

Ants, snout beetles and snails are important pests of vines which require annual chemical control. Although the chemical approach provides satisfactory control of the mentioned pests, the disadvantages are well known. For this reason alternative methods of control are being sought. The object of the study was to field-test different trunk bands for the simultaneous control of snout beetles, ants and snails. Characteristically none of the mentioned pests are capable of flight and consequently can only gain access to the vegetative parts of the vine by way of the trunk.

Experiments were carried out in trellised vineyards at Stellenbosch and Robertson. Two species of snout beetle were involved, i.e. *Eremnus setulosus* Boh. and *Plyctinus callosus* Boh. Differential infestations of the Argentine ant, *Iridomyrmex humilis* (Mayr.) and the brown snail, *Helix aspersa* (Müller) occurred in the same vineyards.

None of the trunk bands were capable of simultaneous control of the three subject pests at a hundred percent level. Formex mixed with coarse salt, was the only band which came close to this goal. Where snout beetles and ants were abundant, which in fact is a common phenomenon in vineyards, the sticky bands Formex, Plantex and Formex on geofabric sufficed.

During the two-year period of testing on vines no phytotoxicity was observed. In view of the fact that viticulture is based on about 2 000 units per ha, it is logical to assume that a pest control approach based on trunk bands would be costly, both in respect of material and labour.

However, the advantages to be gained are manifold. A reduction in toxic chemical sprays for pests would mean a lessening of the chances for pollution of the environment and enhancement of biological control of important pests such as mealy bug and red spider mite. In the long term it could lead to a saving on spray costs.

Oenology

WINE

• Chemistry

WW.2471 53 1 5:

VOLATILE COMPONENTS RESPONSIBLE FOR THE CULTIVAR CHARACTER IN
CABERNET SAUVIGNON WINES. 1981-1987

O.P.H. Augustyn

Research was focussed on the volatile organic compounds present in grapes and wines of Cabernet Sauvignon and aroma related cultivars. These compounds were concentrated by extraction with organic solvents and the complex mixtures separated into individual components by means of gas chromatography. Compounds were identified by co-chromatography of reference compounds and by coupled gas chromatography - mass spectrometry.

Aroma compounds were extracted with freon II. Freon II was preferred to diethyl ether as the latter formed troublesome emulsions, extracted large volumes of ethanol from wines and was difficult to purify. When analysing grape samples enzyme action was inhibited by macerating grapes in 65% methanol water. This practice was, however, found to be unsuitable due to the many artifacts introduced by the 65%. This mixture proved to be exceptionally difficult to purify and was later replaced by saturated NaCl water. Many aroma compounds do not present a molecular (M^+) ion in their mass spectra, thereby making positive identification difficult if not impossible. In such cases chemical ionisation mass spectrometry was used to determine the M^+ ion (methane as reaction gas).

Methoxypyrazines have intense grassy, bell pepper-like aromas and 2-methoxy-3-isobutylpyrazine is known to occur in Cabernet Sauvignon grapes. Attention was, therefore, focussed on the presence of such compounds in the grape cultivars studied here. Sniffing the gas chromatograph eluate indicated the presence of compounds with desired aroma in many samples but also made it clear that the level of these components fluctuates greatly from year to year. These compounds were also present in extremely low concentrations and tended to disappear from extracts stored for any length of time. Consequently the presence of more than one pyrazine was only indicated in Sauvignon blanc grapes. 2-Methoxy-3-isopropylpyrazine and 2-methoxy-sec-butyl pyrazine were identified as grape aroma constituents for the first time during this work. The presence of 2-methoxy-3-isobutylpyrazine was indicated in Cabernet Sauvignon grapes while fragmentary mass spectrometric data indicated its presence in wines from the same cultivar.

The five terpenes identified in Sauvignon blanc grapes could possibly contribute to the fruity floral aroma which sometimes supplements the typical young aroma of wines from this cultivar. Methional was identified in Sauvignon blanc and Cabernet Sauvignon grapes, the first indication that this compound is present in *Vitis*. The various alkadienals present in these cultivars were also identified in *Vitis* for the first time. These aldehydes, with their strong oily-grassy aromas, will, however, form aromaless bisulphite compounds with the SO_2 added during vinification and are therefore not expected to contribute to the aroma of young wines of this type.

The so-called cucumber aldehyde trans-2, cis-6-nonadienal was identified as a constituent of the Sauvignon blanc grape aroma fraction, the first indication of its presence in *Vitis*. This compound will suffer the same fate as the alkadienals during the vinification process. The presence of several interesting aroma compounds, viz quinolene, 2-pentyl furan, 2-butyl thiofene and an indene derivative, was tentatively indicated in Cabernet Sauvignon grapes.

The identification of isoamyl formate in Cabernet Sauvignon wines was of special interest. The aroma of this compound has been described as black currant/plum-like and as such it is the first identification of a compound that could conceivably contribute to the typical berry-like aroma noted in certain Cabernet Sauvignon wines.

From this work it was clear that the aroma impact compounds in Cabernet Sauvignon grapes and wine, as well as in the aroma related cultivars, are present in extremely low concentration. Routine laboratory analysis of these compounds is, therefore, not practical.

J. Marais

A reliable and highly reproducible technique for the freon II extraction of 16 terpenes from grape juice and wine and their gas chromatographic analyses was developed. Terpene concentrations were calculated as actual values for linalool, alpha-terpineol, citronellol, nerol and geraniol and as relative values for the other terpenes by means of an internal standard (2-ethyl hexanol). Standard deviations of the terpenes analysed varied between 1,2 % and 13,9 % for non-settled grape juice and between 2,0 % and 5,2 % for wine.

Variation in gas chromatographic retention times was between 0,04 and 0,1 minutes. The freon extracts of grape juice and wine could be stored at -12 °C for up to six days without marked changes occurring in the relevant terpene concentrations.

Citrus and Subtropical crops

CITRUS

• Physiology

SS.2481 03 1 1:

DEVELOPMENT OF TISSUE CULTURE TECHNIQUES FOR THE PRODUCTION OF
EMBRYOGENIC CALLUS AND PROTOPLASTS IN CITRUS. 1985-1987

M. Nel

The primary aim of the work was to develop techniques whereby *in vitro* selection of citrus could be done for selection of improved planting material. This is particularly important for selecting material resistant to certain diseases. Greening was the most important consideration in the study. Sonoclonal variation via protoplasts was considered the best starting material, with plant regeneration via embryogenic callus. The mastering of the techniques required for these processes was thus necessary.

It has been possible to obtain viable protoplasts from the cultivar Mid-knight Valencia. Some formed callus which later spontaneously become embryogenic, while others only formed callus, some of which could be manipulated in culture to become embryogenic.

An attempt was also made to induce callus formation from embryos in order to increase the chance of variability in the protoplasts subsequently obtained. This was not successful.

The techniques required for growing of plantlets from embryogenic callus were mastered, with plants successfully being re-established in soil.

• Crop science

SS.2481/30/2/10:

FRUIT-SET STUDIES OF CITRUS.

P.J.J. Van Rensburg

Introduction

The Clementine easy peeler is a promising new citrus cultivar being planted in large numbers in the Eastern and Western Cape. A standard fruit-set treatment of a Gibberellic acid (GA3) spray at full bloom was recommended in 1982. This practice resulted in the trees bearing commercial crops. However, a large percentage of the fruit produced is too small to be marketed. In the previous years three trials have been conducted to find methods to increase the average fruit size of the Clementine crop, i.e.:

1. Alternative compounds have been compared with the standard GA3 treatment.
2. Flower thinning trials were conducted.
3. Fruit thinning trials were conducted.

Materials and methods

The three trials were separately executed.

(a) Fruit set with alternative compounds/methods

The different plant growth regulants (PGR) each have a different mode of action in plant responses. The possibility, therefore, exist that some of these, which has already been proven to increase fruit set, will increase the set percentage to such an extent that the fruit size will remain small. In this trial then, different compounds or methods that enhance the PGR content in the flowers and thus increase fruit set, have been applied to Clementine trees. An application of GA3 at full bloom was used as the control and this was compared with the following:

1. GA3 application at 100 % petal drop or four weeks following full bloom (4WFFB).
2. An application of Gibberellins A4+7 (GA4+7) at 100 % petal drop (PD).
3. Girdling of the trunk at PD or 4WFFB.
4. An application of 2,4,5 Trichlophenoxyacetic acid (2,4,5T) at PD.
5. An application of 2,4 Dichlophenoxyacetic acid (2,4D) at 4WFFB.
6. An application of 6 Benzyladenine (6BA) also at full bloom.

Recently farmers started to plant trees of newly released Clementine selections. A trial was therefore conducted to compare the fruit-set reaction of these new selections with that of the standard SRA-63 Clementine selection. Trees were caged in this experiment to simulate block-plantings. The standard GA3 treatment was then applied to the trees. Yield data of these trees were compared with that of cross-pollinated trees.

(b) Flower thinning

The purpose of this trial was to decrease the large number of flowers that normally occur on Clementine trees. The flowers were thinned by spraying the trees at full bloom with various compounds or mixtures. These included the following:

Naphthalene acetic acid (NAA)
Ethephon
Cyclohexamide
2,4,5T plus urea
2,4,5T plus 2,4D

These treatments were followed by a GA3 fruit-set spray at the 100 % petal drop stage which also was the control treatment.

(c) Fruit thinning

The application of GA3 to Clementine trees to enhance fruit set causes the production of a large number of small fruit which is unexportable. The thinning of a portion of these fruit in the early fruit growth phase will enhance fruit size. In this trial trees were sprayed at full bloom with the standard GA3 application. Small fruits of the initial set was then thinned at the 100 % petal drop stage or four weeks following full bloom by spraying the trees with various compounds or mixtures. These included the following:

100 Petal drop	Four weeks following full bloom
Cyclohexamide	NAA
Maleinhydraside	Ethephon
Carbaryl	Cyclohexamide
2,4D plus 2,4,5T	Maleinhydraside
Cyclohexamide plus daminoside	Carbaryl
	2,4D plus 2,4,5T
	2,4,5T plus urea

These treatments were compared with a standard GA3 application at full bloom as control.

Results and recommendations

(a) Fruit-set studies

In this trial the GA3 application yielded better results than applications of 2,4,5T, GA4+7 or 6BA. The standard recommendation of GA3 spray at 10 mg/ℓ at full bloom thus remain the standard recommendation.

The fruit-set reaction of the eight Clementine selections has also been evaluated in the absence of cross-pollinators. In this programme the Nules and Oroval, SRA-70, -84, -85, -88, -89, and -92 selections exhibited a satisfactory fruit-set reaction when sprayed with GA3. It is thus recommended that, depending on the organoleptic evaluation, the above Clementine selections be released for commercial plantings:

(b) Flower thinning

Flower thinning on trees of the profusely flowering Clementine cultivar will lower the initial fruit set and thus increase the final fruit size. In this trial, NAA and Cyclohexamide treatments caused the trees to bear a bigger crop of a better fruit size. This tendency will be investigated in further trials.

(c) Fruit thinning

The application of GA3 at full bloom causes trees to bear a large number of small fruit and thinning of the fruit on the tree has been proven to increase the average size of the fruit on the tree. In this trial, NAA and Ethephon resulted in the thinning of fruit and an increment in average fruit size, but the largest effect was obtained with a Cyclophexamide spray at 4WFFB. These tendencies will be investigated further in additional trials.

PINEAPPLES

• *Upgrading*

SS.2482/07/1/1:

SELECTION AND VEGETATIVE PROPAGATION OF IMPROVED PINEAPPLE CLONES.
1967-1987

E.R. Dalldorf

The aim of this facet was to improve the commercial cultivars of pineapple by plant selection, and determine methods of multiplying selected plants.

A clone which significantly increased a desirable fruit shape over field run plants in the ratoon crop was isolated and made available to growers for further propagation and field evaluation. It has been estimated in the canning industry that an increase of only 5 % in the ring (slice) recovery of fruit, the industry could benefit by R7 000 000-R9 000 000. In cannery tests a number of clones at present being evaluated have produced a slice recovery in excess of 33 %. The mean being in the region of 26-28 %.

Extensive trials with chemical chlorflurenol increased the speed and ease by which plants could be increased over the time consuming method of sectioning plants.

In irradiation studies, very little mortality resulted from treating tops with 2 to 7,5 krad gamma radiation. However, mortality rose sharply with irradiation doses of 10 and 12,5 krad. From the limited number of plants no mutants were recovered.

AVOCADO

• *Technology*

SS.2483/52/1/2:

CONTROLLED- AND MODIFIED-ATMOSPHERE STORAGE OF AVOCADOS. 1985-1988

A.B. Truter

Controlled- and modified-atmosphere trials with Fuerte and Hass avocados from the Duiwelskloof area were undertaken over the past few seasons. Controlled-atmosphere storage at 2 % oxygen + 10 % carbon dioxide and 5,5 °C successfully extended the storage life of Fuerte avocados to four weeks and those of Hass to five weeks. The treatment controlled cold injury in avocados completely as well as most of the post-harvest

physiological disorders such as pulp spot and grey spot, but retarded ripening of the fruit after storage for too long. This led to an increase in the incidence of anthracnose.

Enclosing single fruit in small polyethylene bags in cartons was also successful but impractical as the bags had to be opened prior to ripening. Packing of fruit in large polyethylene bags in cartons retarded ripening for too long and accelerated the development of anthracnose.

The carbon dioxide shock treatment at 7,5 °C one day after harvest with 20 % to 25 % carbon dioxide for 3 to 4 days, followed by storage at 5,5 °C was very successful. Semi-commercial export trials were undertaken with success. The treatment also controlled most of the post-harvest physiological disorders but did not retard ripening after storage.

DIVERSE SUBTROPICAL FRUITS

• Pathology

SS.2485/19/1/2:

DISEASES OF DIVERSE SUBTROPICAL FRUITS: LIFE CYCLE AND CONTROL OF MANGO FLOWER MALFORMATION. 1978-1987

B.Q. Manicom

Nature and extent

The study of this disease was aimed at finding a practicable method of controlling the disease in the field, and to determine the true cause as several possibilities were extant in the literature. Of secondary consideration was to establish the life cycle and infection process of the disease.

Specific findings

None of the available chemicals was found suitable for the control of the disease, nor could hormone sprays reverse the course of the symptoms. However, breaking out infected branches a minimum of three flushes back from the infected terminals, if continued on a yearly basis, rapidly reduces the infection to insignificant levels.

The disease is caused by the fungus *Fusarium moniliforme* which becomes systemic in the plant. Infection is graft transmissible or airborne and can be aided by mites but the critical infection period remains unknown.

SS.2485/19/1/3:

DIVERSE SUBTROPICAL FRUITS: LIFE CYCLE AND CONTROL OF BLOSSOM-END ROT IN GUAVAS. 1982-1988

N.M.G. Grech

Pre- and post-harvest chemical treatments applied to guavas in the Western Cape failed to produce economic reductions in fruit rots over the controls. The most important pathogens causing fruit rot in the Western Cape were *Botrytis cinerea*, *Mucor* spp. and *Phomopsis psidii*. In the Transvaal, *Phomopsis psidii* was the most important pre-harvest pathogen, while *Colletotrichum* and *Mucor* were the most important post-harvest pathogens.

Nut crops

NUTS

• Nutrition

SS.2491/05/1/2:

MACRO- AND MICRO-ELEMENT REQUIREMENTS OF PECAN NUTS. 1969-1987

T.J. Koen

The purpose of this investigation was to determine the nutritional requirements of pecans for optimum production and to establish leaf and soil analysis norms. Two field experiments were conducted on the same

trees, cultivar Moore, planted in 1966 on a Msinga soil series with low P and K status. The first experiment from 1969 to 1977 consisted of a 3³ NPK factorial fertilisation experiment with single tree plots and 2 replicates. The second experiment from 1978 to 1987 was a nitrogen experiment with 9 N levels, single tree plots, replicated 6 times.

The results showed clearly that the optimum leaf N level for maximum production should be between 25 and 26 g N kg⁻¹ for trees younger than 11 years of age and between 25 and 29 g N kg⁻¹ for older trees.

From the results it is obvious that if the N status of the leaves for older trees are in the optimal range, little or no nitrogen will be required.

A yield reaction of P and K applications could only be expected where the soil levels were lower than 23 mg P kg⁻¹ (anion exchange resin extraction) and 68 mg K kg⁻¹.

Optimum leaf composition for P is between 1,3 and 1,4 g P kg⁻¹ and for K between 11,2 and 13,0 g K kg⁻¹.

• Crop science

SS.2491/30/1/1:

TESTING OF MACADAMIA NUT CULTIVARS IN DIFFERENT LOCALITIES. 1969-1987
J.H. Ooshuizen

The adaptability of local and imported macadamia nut cultivars and selections was evaluated at Nelspruit (southern lowveld) and Levubu (Soutpansberg) so that recommendations could be made for commercial plantings. Trees were evaluated for yield and nut quality.

The data, collected over 18 years, demonstrated that macadamias can be cultivated economically in the southern lowveld and Soutpansberg areas. Climate has an important influence on the performance of the different cultivars and selections in these two localities.

Cultivars recommended for the southern lowveld, in order of preference, are Keaau, Kau, Kakea, Nelmak 2, Keauhou and Ikaika. Recommended cultivars for the Soutpansberg area, in order of preference, are Keaau, Kakea, Kau, Selection 26, Keauhou and Ikaika.

SS.2491/30/1/3:

MACADAMIA CULTIVAR EVALUATION IN NATAL. 1984-1987
P. Allan

Vegetatively propagated macadamia cultivars were grown in six ecologically different areas in Natal. Nut quality was tested over a number of years. The warm, moist north-coast area is best for most cultivars tested, although none met the high Hawaiian quality standards.

The relatively newer Hawaiian cultivars Keaau and Kau produce nuts of reasonable acceptable quality in the cooler subtropical areas where the quality of the older cultivars Keauhou, Ikaika and Kakea is more limiting. Hopefully the most recently released Hawaiian cultivars will be even better adapted. Hybrid cultivars are best for the cooler areas but their kernels and those of some other cultivars are more suitable for the dry kernel trade.

Breeding of locally adapted *M. integrifolia* cultivars is an urgent priority. Adequate pest control is essential.

• Chemistry

VV.2491/53/1/1:

NUTS: EFFECT OF THE CHANGES IN OIL AND ANTI-OXIDANTS DURING STORAGE ON THE TASTE OF ALMONDS. 1982-1987
P.C. Fourie

Five different almond cultivars (*Prunus amygdalus*), pecan (*Carya illioensis*) and macadamia (*Macadamia tetraphylla* or *Macadamia integrifolia*) nuts from one production area and two different almond cultivars from three different production areas were used in this study.

Nuts were stored at 30 °C and 55 % relative humidity to induce rancidity. Rancidity was detected in macadamia nuts after two months' and in pecan nuts after four months' storage. However, no rancidity was detected in the almond cultivars even after 16 months' storage. The presence of rancidity was confirmed by means of sensory evaluation (triangular test).

The difference in peroxide values also confirmed that rancidity was not initiated in almonds during storage. Iodine numbers, on the other hand, did not change significantly during storage and could not be used to predict the extent of rancidity. Positive Kreis tests confirmed the occurrence of rancidity in macadamia and pecan nuts.

The presence of high amounts of natural anti-oxidants and specific fatty acid contents appeared to be the determining factors that prevent rancidity in almonds and are responsible for the good storage life of almonds.

Production area had no effect on the quality or storage life of almonds.

Sundry horticultural crops

HORTICULTURAL CROPS

• Physiology

VV.24/11/03/2/2:

PROPAGATION OF DATES THROUGH TISSUE CULTURE. 1982-1988

S.D. Louw

The aim of this facet was to successfully produce date plants via tissue culture and to ensure that the method is commercially viable.

Shoot tips and lateral buds of the date palm (*Phoenix dactylifera*) were placed on a modified Murashige and Skoog (MS) medium which contained 1 mg/l Kinetin, 100 mg/l 2,4-D, 30 g/l sucrose, 3 g/l activated charcoal and 8 g/l agar. The activated charcoal is most important because it acts as an absorbing agent of toxic substances released by the plant.

Nodular callus is produced after 6 months in culture and this gives rise to asexual embryos. These embryos develop further on modified MS medium containing 0,1 mg/l NAA, 0,1 mg/l Kinetin, 30 g/l sucrose, 8 g/l agar and 3 g/l activated charcoal to produce mature plantlets with leaves and a primary root. To obtain a plant with a well-developed root system the primary root is cut off at the base of the plant. The plantlet is then grown on a liquid MS-medium containing 1 mg/l IBA. Polyflora is used as the inert support. A well-developed root system is thus obtained and the plantlet can successfully be established in its normal environment.

VV.24/11/03/3/1:

HORTICULTURAL CROPS: VEGETATIVE PROPAGATION OF DIFFICULT-TO-ROOT OLIVE CULTIVARS. 1982-1988

C. Costa

Trials initially comprised collecting cuttings from mature (bearing) Kalamata trees and preparing them for mist propagation with a view to test the following factors: different rooting hormones, hormone concentrations, number of leaves per cutting, cutting length and thickness, wounding, leaching, soaking cuttings in sugar solutions, different sources of plant material, different rooting mediums, bottom heat, mist schedules, cold storage of cuttings, time of the year, type of shoot used and shading, misting and pruning of stock plants.

Initially all the above treatments gave poor or inconsistent results. It was found that leaf drop cuttings, which was reported to be a problem with this cultivar in the industry, was directly related to hormone concentration and this appeared to cause poor rooting.

Various chemicals were used to try and prevent leaf abscission and a leaf dip of STS (0,01M) was found to be effective. Leaf retention, however, still did not improve rooting. It was only when cuttings were specifically grown for stock plants that consistent rooting could be obtained and then only at the time of the year when a growth flush had "matured".

Carbohydrate analysis of stem and leaf tissue, as well as anatomical studies through stems of easy and difficult to root cuttings, showed no clear trends.

The cause of poor rooting appears to be on an endogenous hormonal level. The specific type of cutting used at the specific time of the year is then in a physiological condition conducive to rhizogenesis.

• Upgrading

VV.24/11/07/1/2:

BREEDING IMPROVED RED-TEA TYPES. 1983-1988

M.P. Kayton

Initially seedlings were planted in soil contaminated with fungal pathogens to determine any variations which could be further exploited by selection and evaluation. However, no results were obtained as there was no difference in die-back between seedlings in the contaminated soil and those in the control. It was then decided to first establish clones and then infect the plants using the toothpick method.

Cuttings were made from several bushes selected from long established plantations. Rooting of the cuttings proved to be a problem and only $\pm 50\%$ of the cuttings rooted. (Similar rooting percentages were obtained in later attempts.) The rooted cuttings were then allowed to develop further under protected conditions in nursery bags and then when stronger, were transplanted into plantations. Here the overriding problem of establishing the plants in plantations became apparent. The results were repeated during follow-up attempts to establish rooted cuttings in plantations. In all cases less than 5% of the cuttings survived longer than four months in the plantations with a continued gradual decrease in plants thereafter. Owing to this problem this facet has been finalised as too few plants remain in the plantations long enough to facilitate any positive progress in further selecting and evaluating different tea-types.

Owing to the object of this facet not being realised because of the previously mentioned problem of establishing plants in plantations, no publications were possible.

• Pathology

VV.24/11/19/1/1:

HORTICULTURAL CROPS: THE ROLE OF FUNGUS PATHOGENS IN THE EARLY DIE-OFF OF RED TEA. 1981-1988

W.A. Smit

The main objective was the determination and identification of those fungi responsible for the die-off of red tea cultivations. Research was suspended from 1982 to 1985, and resumed only during the latter half of 1985.

More than 10 000 two-/three-year-old healthy red tea plants were inoculated and evaluated in the main production areas of Citrusdal (FFTRI Experiment Farm), Clanwilliam and Van Rhynsdorp (private farms) between 1985 and 1987.

The primary pathogens included *Diaporthe phaseolorum*, *Macrophomina phaseolina* and *Neocosmospora vasinfecta*. Other important pathogens are *Phoma* sp., *Rhizoctonia* sp. and *Sphaeropsis* sp.

All these fungi have been determined to be seedborne and to sporulate and survive on dead red tea tissue above and below soil level. In addition *Macrophomina phaseolina* and *Neocosmospora vasinfecta* are soilborne due to sclerotia and chlamydospores, respectively.

Stress of red tea plants play a very important role in disease development. Healthy plants are mainly infected when predisposed simultaneously by non-manageable and manageable stress conditions.

This is the first report of *Diaporthe phaseolorum* causing cankers and die-off of perennial plants in South Africa.

The red tea cultivar Nortier is the only selected type cultivated throughout the production area. All red tea plants are therefore susceptible to the pathogens identified.

No lesions developed on red tea plants inoculated with any of the pathogens during winter (June). Lesions developed rapidly on plants inoculated in spring (August/September).

There were no differences in disease development on plants inoculated with single ascus, single ascospore or single conidium isolates of *Diaporthe phaseolorum* or with isolates from the different geographic areas or different parts of the plant.

Diaporthe phaseolorum isolates from symptomless flowers, crowns of old dead plants and crowns of dead weeds were highly pathogenic. A benomyl spray immediately after harvesting prevents infections with *Diaporthe phaseolorum*.

All the seedborn pathogens in unscarified hard seeds are eliminated when submitted to a hot-water treatment (60 °C for 10 minutes).

The sclerotia of *Macrophomina phaseolina* and chlamydospores of *Necosmospora visinfecta* in clean cultivated red tea fields and seedbeds are decreased to an acceptable level when subjected to a four-week irrigation period (25 % soil moisture) in December.

The complex of causal fungus pathogens of early die-off disease of red tea was established. Five

practices were identified and circumscribed for implementation by producers, whereby this economically very serious disease can be eliminated completely.

• *Technology*

VV.24111/52/2/1:

HORTICULTURAL CROPS: PREPARATION OF ACCEPTABLE INSTANT PRODUCTS
FROM WASTE MATERIALS OF ROOIBOS TEA. 1983-1987

E. Joubert

The preparation of instant tea consisted of extraction of soluble solids, concentration, drying and agglomeration. Stirred batch and fixed-bed extraction systems were used. Drying of tea concentrates was achieved by freeze or spray drying. Tea stems, i.e. waste material, and leaves were analysed for phenolic composition and yield of soluble solids. The effect of extraction temperature, time, mass ratio of extract:tea and flow rate of extract on extraction of soluble solids and polyphenols was determined with a single stage batch extraction system. Sensory analyses were used to determine flavour differences between freshly brewed tea and instant tea.

Stems contained less soluble solids and total polyphenols than leaves, with the soluble solids of the stems more affected by the pH of the extraction solvent. An increase in the pH resulted in increasing extraction of soluble solids. However, the taste and colour of the extract was unacceptable. Extract concentration and yield of soluble solids increased linearly with an increase in temperature from 23 °C to 90 °C. Increasing the mass ratio decreased extract concentration, but increased yield. Both extract concentration and yield decreased with an increase in flow rate. Extraction of total polyphenols increased with an increase in temperature, mass ratio and decrease in flow rate. Agglomeration of spray-dried tea powder was necessary to obtain instant properties. No significant flavour difference ($P > 0.05$) could be established between spray and freeze-dried tea. However, flavour losses occurred with processing of the extract resulting in a highly significant difference between freshly brewed tea and instant tea.

ANIMAL PRODUCTION PROMOTION

ANIMAL PRODUCTION AND ANIMAL PRODUCTS RESEARCH

Supporting animal research

ANIMALS

- *Nutrition*

VS.3133/05/1/6:

FEED INTAKE IN THE NUTRITION OF FARM ANIMALS: FEED CHARACTERISTICS.
1981-1987

J.P. Pienaar

The study had two objectives. The first was to study changes in particle size and specific gravity in the rumina of sheep and to determine their effects on particle rate of passage.

The second objective was to determine the effect of the intra-ruminal infusion of starch and sucrose at two rates, on roughage digestion and flow kinetics.

The first objective could only be achieved partially because of inadequate techniques by which the dynamic changes in specific gravity during fermentation could be assessed.

It was thought originally that the separation of particles into fractions with different specific gravities, could be achieved by displacement, using a range of displacement liquids with different specific gravities. However, it soon became apparent that when aqueous solutions were used as displacement liquids, the displacement solution was absorbed into the particles, and also changed the specific gravity of the particles.

AGRICULTURAL RESOURCE UTILISATION RESEARCH

RESOURCE RESEARCH

Primary resources

SOIL

- *Soil science*

GB.5111/32/1/5:

NITROGEN-SOIL WATER INTERACTIONS FOR EFFICIENT NITROGEN FERTILISATION
UNDER DRYLAND CONDITIONS IN THE SUMMER RAINFALL CROPPING AREA.
1983-1987

L. Korentajer

Nitrogen fertilisation is presently a major cost item for the South African farmer. For example, in 1985 the total costs of N fertilisation exceeded R500 000 000. These high costs could be decreased by using fertiliser amounts commensurating with the climatic conditions prevalent in South Africa, in particular the frequently occurring drought, i.e. moisture stress.

This project was launched to determine the effects of soil moisture stress on N uptake and yields of dryland wheat. The project was conducted in collaboration with the Fertiliser Society of South Africa, which provided field facilities for the study. A model relating wheat yield level to the amount of seasonal moisture stress (S) and the level of applied nitrogen fertiliser (N) was proposed. The model was calibrated using the results of a three-year N response study conducted at Viljoenskroon, O.F.S. Yield and climatological data obtained from several other N x P x K trials conducted by the Small Grain Centre (Bethlehem, O.F.S.) were used to validate the model.

The model was used to estimate the effects of stress index (S) on N_{max} and N_{opt} , i.e. the amounts of nitrogen fertiliser needed to maximise profits, respectively. N_{max} was largely independent of S, whereas N_{opt} sharply increased with decreasing stress. Changes in the price ratio P_N/P_Y^{-1} (the cost of N fertiliser, and the price of grain, respectively) had only a minor effect on N_{opt} . These results indicate that a simple model based on climatological data can be used to estimate yield and N fertiliser requirements of dryland wheat in some areas of the summer rainfall region.

H.5111/32/3/2:

WATER HOLDING CAPACITY OF SOILS IN THE HIGHVELD REGION.

A.M. Hattingh

The field capacity (FC) of nine soils (clay contents varying from 4,9 to 35,1 %) were determined in 20-litre pots under glasshouse conditions. Soils were saturated with water and covered with plastic. The pots were initially mass-measured every hour and later with longer intervals. Matrix potential (Ψ_m) was recorded at the same time. Both Ψ_m and soil water content were plotted against time. The point where the change in soil water potential and water content with lapse of time dropped below 5 %, was recorded for each soil. Water content at FC ranged from 17,2 % to 29,5 %. Mean lapse of time was 7,5 hours and Ψ_m at FC ranged from -3 to -4,8 kPa. Clay content has no relation with Ψ_m at FC ($r=-0,53$) or with lapse of time to FC ($r=-0,12$). The correlation coefficient for the relationship between clay content and water content at FC is 0,94, for the nine soils.

Thirty nine determinations of FC at several depths in 10 soil profiles were carried out *in situ*. The 5x5 m plots were saturated, covered and Ψ_m was monitored with mercury tensiometers. Water content was measured gravimetrically. Clay content ranged between 6,9 % and 55,3 % and water content at FC varied from 10 to 37 %. Mean lapse of time to FC was 22,6 hours and Ψ_m at FC ranged from -1 to -8,9 kPa. The same tendencies as in the pot determinations were found, i.e. no relation between clay content and Ψ_m at, and time duration to FC (correlation coefficients are -0,69 and 0,146, respectively). The correlation between clay content and water content at FC is 0,82. Water content at FC is relatively much higher (5 to 7 %) when determined in pots.

To determine whether FC is a significant point on the water retention curve, a pot trial was conducted. The water content at -5, -10 and -33 kPa of nine soils were determined. From the preceding work it was clear that FC was near -5 kPa. Soils were wetted to -5 kPa, -10 kPa or -33 kPa, respectively and were refilled to the predetermined water content every 4 to 5 days. Six sunflower plants were grown in each pot. No plant was under any stress at any time. Leaf area, plant length and dry plant mass were higher for soils wetted to -5 kPa in comparison to soils wetted to -10 kPa and -33 kPa. The difference in plant growth between soils wetted to -10 kPa and -33 kPa was highly significant too. Water consumption of plants which were wetted to -5 kPa was the highest, to -10 kPa intermediate and it was the lowest plants which were wetted to -33 kPa. It is therefore essential to determine FC in order to produce maximum plant production.

To determine the influence of clay content and cation exchange capacity (CEC) on the water content at -10 kPa, 250 soils were used. The same was done at -33 kPa and -1 500 kPa by Lambooy (1984). The multiple correlation coefficient for the relationship between clay content, CEC and water content at -10 kPa is 0,94. Two soils with the same clay content, e.g. 35 % but different CEC values, e.g. 6 and 28 me/100 g soil, have totally different water contents at -10 kPa, e.g. 26,6 % and 49,1 %, respectively. It will be shown later that CEC has a similar influence on *in situ* FC.

It can be misleading to relate FC directly to any Ψ_m (e.g. -33 kPa for soils with high clay contents or -10 kPa for soils with low clay contents) as is done traditionally. To predict FC from water contents at a particular Ψ_m it has been shown in this study that at least five Ψ_m values should be used for different clay contents, viz -5 kPa for 0 to 10 % clay content, -10 kPa for 10 to 20 %, -20 kPa for 20 to 30 %, -33 kPa for 30 to 55 % and -100 kPa for soils with clay content higher than 55 %. There exist, however, a very high significant correlation between water content at any of the Ψ_m values and FC.

Beukes (1985) found an equal significant correlation between -10 kPa water content and FC. His equation is as follows: Field capacity = 0,558 (-10 kPa water content) + 4,43 (Equation I). This Equation I was used in further discussions for predicting FC, because the correlation coefficient for the relationship between *in situ* FC found in this study and the answers found with Equation I is 0,97. Equation I is used to bring about uniformity and to show that results from the Highveld Region and the Winter Rainfall Region are reconcilable.

The equation to predict the water content at -10 kPa from clay content and CEC can be substituted in Equation I to obtain an equation to predict FC direct from clay content and CEC.

$$FC = 0,239 \text{ clay \%} + CEC - 0,0032 CEC^2 - 0,0054 \text{ clay \%} * CEC + 6,955 (R=0,95)$$

Field capacity can thus be predicted with very high accuracy from clay content and CEC.

Volumetric FC cannot directly be predicted with equal success from an equation. However, volumetric FC can be predicted accurately if the predicted gravimetric FC is multiplied with the *in situ* bulk density.

Wilting point was determined on nine soils in three-litre pots under glass-house conditions, following the procedures of Peters (1965), and using the same nine soils as for the FC determination in the pots. The water content at wilting point of sunflower (SO 77) and maize (PNR 432) was compared with water content at -1 500 kPa. The relationship between wilting point and water content at -1 500 kPa is highly significant ($r=0,99$).

$$\text{Wilting point} = 0,702 (-1\ 500 \text{ kPa water content}) + 0,215 \text{ (Equation III)}$$

Wilting point can also be predicted by clay content and CEC ($R=0,96$)

$$\text{Wilting point} = 0,07557 \text{ clay \%} + 0,00217 \text{ clay}^2 + 0,4053 CEC + 0,00217 CEC^2 - 0,00446 \text{ clay} * CEC + 0,569 \text{ (Equation IV)}$$

The wilting point of sunflower and maize is not exactly the same, although no explanation could be found as to soils on which the maize will have a higher wilting point than sunflower and *vice versa*.

Plant-available water content cannot be determined directly from clay content and CEC ($R=0,66$). It can, however, be calculated from the difference in water content between FC and wilting point.

H.5111/32/3/3:

INFLUENCE OF CROP RESIDUE ON THE MOISTURE CONTENT AND OTHER PHYSICAL PROPERTIES OF SOILS IN THE HIGHVELD REGION. 1982-1987

A.M. Hattingh

Many soil tillage practices were developed during the last decade or so. This brought along confusement on a large scale amongst producers, because problems are considered only from one point of view.

Many factors have to be taken into account, e.g. soil conservation (erosion control), soil water conservation, economy, soil type, climate and farming practices.

Questions which arise are:

- Is conservation tillage necessary on clay soils for erosion control? (Wind and water erosion occur more readily on sandy soils.)
- Is soil water conservation enough to improve yield, because clay soils have a low infiltration rate and a high run-off rate?
- Is there no soil compaction on clay soils and is a deep tillage not necessary on clay soils?
- Are the benefits of using the stubble mulch on the lands for erosion and water conservation greater than using the stubble for grazing purposes on or off the lands?

The purpose of this investigation was to compare 12 tillage practices to determine the influence of stubble mulch on the soil water content and other physical as well as chemical properties of soils. Tillage costs of the 12 practices were also compared.

This trial was conducted on the Brakspruit Experimental Farm at Potchefstroom on a Makatini serie of the Hutton soil form. The slope was 1 %. The soil was formerly under maize production.

Three replicates were used.

W.5111/32/2/4:

DIAMMONIUM EDTA VERSUS THE STANDARD METHOD FOR EXTRACTION OF SOIL
Cu, Zn, Mn AND Fe IN THE WINTER RAINFALL REGION. 1981-1988

T. Hammond

Various modifications of standard technology and alternative extraction procedures used elsewhere, were investigated and compared with the standard (NH_4) EDTA procedure.

Slotted quartz and graphite furnace as atomic absorption technology

Techniques for the determination of trace elements by means of a slotted quartz tube suspended over the atomic absorption burner and the graphite furnace were investigated in respect of precision and accuracy at low concentrations of Cu and Zn in soil extracts.

No increase in sensitivity was found for Cu and Zn at concentrations of 0,10 to 10,0 mg kg^{-1} , determined with the slotted quartz tube.

Technical problems such as alignment of tube on the burner, cracking of quartz tube with cooling, salt build-up on tube slot and time consuming sample turnover rendered this technique unsuitable for routine and research procedures.

Background problems such as the scattering and absorption of some of the light by molecules or solid particles in the light path and interferences such as physical (solution viscosity) and chemical, excess concentration of anions (nitrates, sulphates and phosphates) causing loss of analyte as well as slow sample turnover made the graphite furnace suitable for research purposes only.

Precision of determinations

TABLE 1 - Precision of trace element determinations (% C.V. for replicates)

Extraction procedure	Cu	Zn	Mn	Fe
EDTA $(-\text{NH}_4)$	5,8	7,2	3,6	3,2
Mod. Bray	6,8	10,2	5,4	10,3
ISFEI $(-\text{NA})$	7,5	9,9	4,3	6,0
ISFEI $(-\text{NH}_4)$	2,7	8,8	4,4	3,8
DPTA	8,9	4,4	2,3	2,9

From the results it is evident that precision for (NH_4) EDTA, DTPA and ISFEI (NH_4) tended to be of similar magnitude and somewhat superior to the other extractants.

Comparison between low pH (4-6) and high pH (7-8) extractants for Cu, Zn, Mn and Fe

On 37 soils, similar amounts of Cu and Zn were extracted by high and low pH extractants, although values were slightly higher for low pH extractants. Low pH extractants gave considerable higher values of Mn and Fe.

Fractions of Cu, Zn, Mn and Fe determined in five alternative extractants varied but were correlated significantly with amounts extracted with the standard $(\text{NH}_4)_2\text{EDTA}$ method.

The relation between extractable Cu, Zn, Mn and Fe and soil pH, clay, silt and organic matter contents

No clear relation was found between extractable Cu, Zn, Mn and Fe and pH of 150 random soil samples. Within some pH ranges some relation, although of no practical significance, was found for Cu, Zn and Mn.

Clay, silt and organic matter percentages correlated significantly with Cu, Zn and Mn fractions in the soils investigated. Correlations between extractable Fe and these soil properties seldom reached significance.

As soils in the Winter Rainfall Region usually contain similar clay and silt percentages, it is evident that silt also plays an important role in the trace element-supplied power of these soils.

Effect of liming on extractable Cu, Zn, Mn and Fe

Soils representing five major soil forms of the region were limed from pH 4,5 through 5,5 to about 6,5. The effect of soil forms on extractable elements were greater than the effect of liming.

Liming generally reduced the amounts of Fe, Mn and Zn extracted, but had little effect on the amounts of Cu extracted. High pH extractants tended to give lower Fe, Mn and Zn values than low pH extractants, while Cu was insignificantly effected by the pH of the extractant.

In conclusion it seems that any of the alternative extractants can be used to index Cu, Mn, Zn and Fe in soils of the Winter Rainfall Region, provided it has been calibrated against the standard $(\text{NH}_4)_2\text{EDTA}$ procedure.

CLIMATE

• Meteorology

GB.5113/33/1/9: CLIMATE: TOTAL RADIATION IN THE WINTER RAINFALL REGION. 1980-1987
G.W. Matthee

A study has been made regarding the accuracy with which solar radiant energy received at the surface in the Western Cape can be calculated from the duration of full sunshine as recorded with Campbell-Stokes sunshine recorders. The Ångström-type formulas as applied by Prescott (1940), De Boer (1961) and Louw (1965) were tested. The best results for calculation of total daily energy were obtained with the modified De Boer method by first calculating hourly values and summing these over the day. Good results were also obtained with the Ångström-formula using the constants calculated for the RSA.

The average values of the constants R_Δ and α for the Western Cape required to apply the De Boer formula were calculated for each hour of the day for every month and tabulated.

GB.5113/33/1/11: THE DETERMINATION OF LATE FROST AND MAXIMUM TEMPERATURES ALONG THE ORANGE RIVER WITH REFERENCE TO THE CULTIVATION OF WHEAT. 1984-1987
S.L.M. Fleischer

The object of this facet was to map the areal probabilities of late frost and early maximum temperature extremes along the Orange River. This area is frequently exposed to temperature extremes and because of its importance as a wheat growing area, it was hoped that results from this research could help to alleviate these problems.

However, unfortunately, this area has only a very sparse network of weather stations with varying years of data. This facet presented the greater problem, as thus the reliability of data analysis was immediately impaired.

Although this was not so problematic with the maximum temperatures, it proved to be a major stumbling block with the topography-related minimum temperatures.

Broadly speaking, the areal probabilities of maximum temperature extremes - as mapped by the SYMAP-programme - show the tendency of increasingly higher probabilities towards the West. This was expected owing to the decreasing altitude to the West.

Vice versa, probabilities of minimum temperatures show the tendency to increase towards the East and the higher ground. However, more micro-climatic regions of minimum temperatures could not be established.

For the irrigation areas Sandvet, Vaalharts and Rietrivier, probability curves for several temperature ranges for both maximum and minimum temperatures were drawn, as for each station along the Orange River.

GB.5113/33/1/12:

THE ESTIMATION OF MEAN HOURLY TEMPERATURES FROM DAILY MAXIMUM AND MINIMUM TEMPERATURES IN THE WINTER RAIN CROPPING AREA. 1985-1987

A.L. du Pisani

Five different techniques to calculate the hourly temperature from daily maximum and minimum or 08h00 temperature were evaluated. In the case of two of these techniques the daily march of the temperature was simulated by sinus functions. In another two techniques the daily march was approximated by the average march at the weather station concerned. The only difference between the last two methods was that in the case of one, the temperature measured daily at 08h00 was used instead of the daily minimum. With the fifth method it was assumed that the temperature increases and decreases linearly between successive occurrences of the maximum and minimum.

The temperature measurements at five weather stations in the Winter Rain Region were used to evaluate methods. The standard deviation of the differences between measured and calculated hourly temperatures were used to establish the relative accuracy of the different calculation techniques. As an indication of relative positive or negative bias in the calculated values the absolute values of the mean errors were used. In terms of both these criteria the best results were obtained with the techniques based on the mean hourly march of temperature and the daily maximum temperature and the temperature measured at 08h00.

Frequency distributions were drawn up with calculated hourly values and compared with those drawn up with measured values. In all cases there was no significant difference between the sets of frequency distributions according to the tests applied.

Chilling units for deciduous fruit trees were calculated for the 1984-season and compared to those calculated with measured temperatures. The agreement was not consistently satisfactory. The calculated temperatures cannot, therefore, be recommended for application such as the calculation of chilling units where different weights are given to different ranges of temperature.

GB.5113/33/2/1:

CLIMATE: CORRELATION BETWEEN WEATHER FACTORS AND PICKING DATES OF APPLES. 1973-1986

G.W. Mathee

The relationship between the weather during winter, and the growing season and the South African Apple and Pear Producers Association's recommended date for harvesting Starking and Granny Smith apples, was investigated.

Good correlations were established between the number of days from full bloom to the recommended optimum harvest date and the full-bloom date (days after 31 August), temperature in the early and late summer and Richardson cold units during winter. The latter was most significant in the case of Starking. October and November average temperatures were most significant in the case of Starking whereas November and December temperatures gave the best results for Granny Smith.

Multiple regressions which gave the best prediction of harvest date, accounted for 80 % and 88 % of the variation in optimum harvest date for Granny Smith and Starking, respectively. The optimum harvest date can be predicted on the first of December and January for Starking and Granny Smith, respectively. An index to quantify optimum ripeness is suggested.

GB.5133/33/3/3:

CLIMATE: HIGH PALMETTE SYSTEMS AS WINDBREAKS. 1978-1987

G.K. Viljoen

The purpose of this experiment was to determine the efficiency of plum trees trellised on a high palmette system as a windbreak.

During July 1978 an experimental plum orchard was established in the windy Groot-Drakenstein area for this purpose. Owing to the fact that most of the trees died during the first two seasons as a result of

waterlogging the experiment in this particular orchard had to be discontinued. The experiment was then continued in an existing plum orchard not specially designed for this purpose.

An attempt was made to protect one half of the orchard by trellising the windward tree row as high and dense as possible. The windward row of the other half was treated normally. The wind was monitored at different distances from the windward edge in both halves. The fruit were examined for wind damage.

After two growing seasons it became clear that it was impossible to establish an efficient windbreak as many trees in the shelter-row had died as a result of bacterial cancer and the experiment was discontinued. However, the results obtained up to that stage showed that windspeed is markedly reduced in a trellised orchard. The average reduction varied from 37 % at the windward side of the orchard to 83 % in the middle and 70 % on the leeward side.

Damage to fruit as a result of wind action was less than 5 %.

RESOURCE UTILISATION RESEARCH (CROPS)

Field crops

OTHER FIELD CROPS

• Nutrition

W.5214/05/1/1:

THE INFLUENCE OF INCREASING LEVELS OF NITROGEN FERTILISER APPLICATIONS ON PEPPERMINT (CV. BLACK MITCHAM) WITH REGARD TO OIL YIELD AND COMPOSITION. 1983-1988

H.H.M. van Gelder

The purpose of this experiment was to study the effect of different levels of nitrogen fertilisation on the yield and quality of peppermint oil.

The trial was carried out at Outeniqua Experimental Farm over a period of four years (1983 to 1987). The total nitrogen levels ranged from 112 kg to 392 kg ha⁻¹, applied at three stages. One month after regrowth started in early spring (September), 25 % was applied, followed by 50 % two months later and the last 25 % was applied four and a half months after regrowth started.

Although no N reaction on herbage production was obtained during the first year an increase of 17 400 kg ha⁻¹ in peppermint herbage was obtained during the 1984/85 season by increasing the nitrogen application rate from 112 to 280 kg ha⁻¹. During the 1985/86 season, weed infestation and poor climatical conditions prevented evaluation of data.

During the 1986/87 season, herbage production was increased by 6 250 kg ha⁻¹ by increasing the N application from 224 to 392 kg ha⁻¹. This study revealed a good correlation between peppermint herbage yield and oil production. With regard to oil composition, the menthol content decreased from 44,2 % to 41,6 % while the menthone content increased from 11,2 to 14,0 % in the 1983/84 season when the nitrogen application rate was increased from 112 to 280 kg N ha⁻¹. These treatments reduced the menthol content from 42,4 to 31,3 % and increased the menthone content from 20,4 to 27,4 % during the following (1984/85) season.

The same trend occurred during the 1986-1987 season when the N application was increased from 224 to 392 kg ha⁻¹. The menthol content decreased from 41,7 to 39,6 % and the menthone content increased from 19,2 to 23,5 %. This response is ascribed to a retarding effect of high nitrogen levels on maturity and menthol synthesis.

Plants harvested two weeks later on the same plots, just after the full-bloom stage, had markedly higher menthol- and lower menthone contents than during the earlier harvest performed just prior to the full-bloom stage. Thus, it can be expected that later harvesting in the case of high nitrogen treatments should result in higher menthol levels as well as lower levels of menthone in the obtained oil.

Owing to this improvement in oil quality, it is recommended that harvest should take place at a later stage, when high nitrogen levels are applied.

• *Upgrading/Crop science*

- D.5214/07/1/1: OTHER FIELD CROPS: UPGRADING OF EXISTING CHICORY CULTIVARS IN THE EASTERN CAPE. 1974-1983
J.D. Aucamp
- D.5214/30/1/1: OTHER FIELD CROPS: CHICORY SEED PRODUCTION IN THE EASTERN CAPE. 1972-1986
E.B. Birch and J.D. Aucamp

This is a joint final report, covering eleven pilot trials on seed production (up to 1976) and a programme of seed production (10 trials) and progeny testing (15 trials) from 1974 to 1986. The system which worked well (from 1980) comprised selecting on the basis of germination per centage seed produced at Grootfontein College of Agriculture in the Karoo Region for planting in similar progeny trials at Bathurst (from May to August) and Dohne (from November to January). Selection of stock roots for planting for seed production at Grootfontein was based on yield and absence of bolters, black spot disease and branched roots (from Bathurst data) and SG (from Dohne data). Stock roots were generally provided by the Dohne progeny trial.

Good quality seed was produced consistently, with yields of up to 527 kg/ha. Potential seed yield (based on best seed yield of individual plants) seems to be 2,8 t/ha.

In the upgrading facet there was no consistent trend for selected lines to perform progressively better in relation to imported seed, either in regard to mean yields, best yields, or proportion of plants which bolt (to seed in the first year) or with black spot or branched roots. It would seem as though the objectives of the upgrading facet were not fulfilled even though many lines outyielded control (imported) cultivars by a considerable margin in the progeny trial, significantly so in some of the cultivar experiments.

Both the seed production and upgrading facets were terminated before their expected dates of termination.

RESOURCE UTILISATION RESEARCH (ANIMALS)

Ruminants

LARGE STOCK

• *Reproduction*

- N.5311/04/1/2: LARGE STOCK: OESTRUS AND OVULATION IN MATURE FEMALE BEEF CATTLE AS AFFECTED BY CHANGES IN LIVE MASS IN THE HIGH RAINFALL SOURVELD AREAS AT DUNDEE. 1978-1985
B.P. Louw, C.R. Thomas and A.W. Lishman

Ovarian activity was studied in 36 dry, *Bos taurus* cows fed to achieve different rates of body mass loss and gain in a 2 x 2 factorial experiment. Cows were fed hay to supply either 70 % (Tr. 1,2) or 40 % (Tr. 3,4) of their metabolisable energy (ME) requirements for mass maintenance until they became anoestrus. Following a 90-day period during which mass was maintained the animals were fed hay *ad lib.* and either 1 kg (Tr. 1,3) or 4 kg (Tr. 2,4) of maize per cow per day until they resumed luteal activity.

During the initial 14 days after maize feeding commenced each cow was mass-measured every second day in order to obtain an estimate of gutfill. Oestrus activity was monitored twice daily by observing marker bulls joined with cows. Ovarian activity was assessed throughout the trial by weekly palpations of the ovaries. Four cows failed to cease ovarian activity despite having lost about 31 % of their initial mass. Thirty-one cows lost approximately 100 kg or 21 % of their initial mass, and 1,1 condition score points over a period of about five months before they became anoestrus.

Treatment did not influence mass and condition losses and gains, as well as the time taken for cows to cease and resume ovarian activity. Gutfill was estimated at $25,9 \pm 10,5$ kg. Cows were between 35 and 57 kg heavier ($P < 0,01$) at the resumption than at the cessation of ovarian activity. The estimate of gutfill in each cow was subtracted from the actual mass at resumption of ovarian cycles. At the resumption of ovarian activity the mean adjusted mass ($389,9 \pm 44,9$ kg) was significantly ($P < 0,01$) greater than that at the cessation of ovulatory cycles ($368,6 \pm 39,1$ kg). The mean condition score at the re-establishment of ovulation

(2,35 ± 0,34) was also significantly ($P < 0,01$) higher than that at the cessation of ovarian activity (1,72 ± 0,37).

Treatment did not influence conception rates in cows. Over all treatments 85 % of the cows conceived at the resumption of ovulatory activity.

SMALL STOCK

• Norm studies

K.5312/50/1/3:

SMALL STOCK: THE INFLUENCE OF FEEDING ADDITIONAL ENERGY ON THE PRODUCTION AND QUALITY OF MOHAIR PRODUCED BY ANGORA EWES AND THEIR KIDS GRAZING ON NOORS (*EUPHORBIA COERULESCENS*) AND SUCCULENT MOUNTAIN SHRUB VELD. 1983-1987

P.D. Grobbelaar, C.J. Greeff and A. Koen

Procedure

The influence of different levels of chocolate maize or maize meal on the production and quality of mohair produced by adult Angora ewes and their kids grazing two different veld types was investigated. This facet was conducted in two phases. During phase one the animals (135) were divided into 5 groups of 27 each and were kept on succulent mountain shrub veld. They were treated as follows:

Group	Additional feeding per goat per day
Group 1 (control)	No additional energy
Group 2	300 g chocolate maize
Group 3	300 g maize meal
Group 4	600 g chocolate maize
Group 5	600 g maize meal

During phase two 150 Angora ewes were divided into 3 groups of 50 each and were kept on Noors veld. Only chocolate maize at two different levels (300 g and 600 g/goat/day) were used in this trial.

In both stages the offspring of the ewes were kept under the same conditions as their mothers (described above). For both phases additional feeding was given during the following critical physiological stages:

Duration (weeks)	Physiological stage
2	before mating
6	during mating
4	last third of gestation
16	lactation
32	kids after weaning

Mohair samples were taken during normal shearing times (3 times per year) and were analysed for different physical properties such as hair mass (raw and clean) fibre diameter and the variation along the fibre. Body mass of these ewes was taken just after shearing and, for the kids, every two weeks.

Conclusion

Ewes

For most of the economically important triats like body mass, fleece mass and fibre thickness, relatively small differences were found between the control group and the various treatment groups. It seems, however, that chocolate maize gives slightly better results than maize meal.

Additional energy feeding has a marked influence on the lambing percentage, twins born and weaning percentage.

Kids

Additional energy feeding leads to better development in kids which then reach a mean body mass of 27 kg (which is considered as the minimum mass required for successful reproduction) at an early stage (in this case at 12 months of age) as well as a higher hair production.

In general, kids that have been well fed and looked after will be better producers and reproducers throughout their life time.

RESOURCE UTILISATION RESEARCH (PASTURE)

Pasture

VELD

● Physiology

D.5411/03/1/4:

VELD: ANNUAL CARBOHYDRATE USE AND REPLENISHMENT CYCLE OF *ACACIA KARROO* IN THE CENTRAL GRASSVELD OF THE EASTERN CAPE. 1986-1987

W.R. Teague

The use and replenishment of carbohydrate reserves in *Acacia karroo* are closely related to the successive growth events of the annual cycle. Each time shoot and leaf or reproductive organs appear and begin to develop, reserves decline. Replenishment begins soon thereafter when recently-emerged leaves are still very small. This suggests that any new leaf and shoot produced are supported by the older plant parts only for initiation and early emergence, and that thereafter they are at least self-sufficient and export when very young. It appears that after each successive growth-event in the annual cycle, the initiated organs become self-sufficient and then replenish reserves used, before proceeding with the next event.

As with aerial growth, the carbohydrate reserve use and replenishment cycle is not changed with increasing water stress. However, since increasing water stress slows down the time taken for replenishment, it probably also has the effect of slowing down the beginning of the next annual growth event, as well as the growth of organs already initiated. By growing in flushes and replenishing reserves before proceeding with the next flush, they also ensure that they do not over-extend themselves and are able to cope with harsh environmental conditions that arise, and also probably damage by herbivory.

D.5411/03/1/5:

VELD: CARBOHYDRATE REPLENISHMENT IN *ACACIA KARROO* FOLLOWING DEFOLIATION IN THE CENTRAL GRASSVELD AREAS OF THE EASTERN CAPE. 1986-1987

W.R. Teague

Total non-structural carbohydrate levels dropped significantly after defoliation at the different intensities and phenophases when treatments were affected. The decreases were small with the 25 % defoliation but reached 50 % depletion after defoliation at the higher intensities (50 % and 75 % leaf removal).

In contrast, recovery was much more rapid following the heavier defoliations. It was also more rapid following defoliation in the second half of the season, possibly because *A. karroo* plants normally replenish reserves in the second half of the growing season. The significantly low TNC levels of the 75 % defoliation at both phenophases probably indicate that these plants had not yet replenished by the end of the season following this intensity of defoliation.

D.5411/03/1/6:

VELD: THE EFFECT OF DEFOLIATION ON THE RATE OF PHOTOSYNTHESIS OF *ACACIA KARROO* IN THE CENTRAL GRASSVELD OF THE EASTERN CAPE. 1986-1987

W.R. Teague

Defoliation by goats increased the rate of photosynthesis in the remaining leaves. Results at the dry site were very variable and masked the considerable increase in rate of photosynthesis measured at the wet site. At the

wet site, rates were 200 %, 150 % and 140 % greater than the control for the 25 %, 50 % and 75 % defoliations, respectively.

Since total non-structural carbohydrate levels decreased up to 50 % following these defoliations, it is clear that both reserves and increased rate of photosynthesis are important to *A. karroo* in recovering from defoliation.

D.5411/03/1/7:

VELD: THE EFFECT OF WATER STRESS ON THE RATE OF PHOTOSYNTHESIS AND ROOT/SHOOT BALANCE FOLLOWING DEFOLIATION OF *ACACIA KARROO* IN THE CENTRAL GRASSVELD OF THE EASTERN CAPE. 1986-1987

W.R. Teague

It has not been possible to satisfactorily establish *Acacia karroo* plants in drums. In addition, a trial at the University of the Witwatersrand (personal communication from Prof. B.H. Walker) has obtained very poor results with trees growing in restricted rooting areas, because of the restrictions to the development of roots. As a consequence, it is recommended that this facet be terminated since it would be impossible to conduct this trial in the field.

• Ecology

D.5411/27/1/2:

VELD: MORTALITY AND HETEROTROPHIC CONSUMPTION OF *ACACIA KARROO* LEAVES IN THE CENTRAL GRASSVELD OF THE EASTERN CAPE. 1986-1987

W.R. Teague

In any 15-day period through the growing season approximately 3 % and 11 % of leaves would, on average, be lost owing to mortality alone and avian and insect consumption plus mortality, respectively.

The differences in leaf and shoot masses between the control plants and those protected from insect and avian consumption were generally large, particularly in the first half of the season. This coincided with the observation that *Acacia karroo* plants were very sensitive to defoliation early in the season.

Avian and insect defoliation did not have the stimulatory effect on *A. karroo* production that goat defoliation has. The presence of sap-sucking, debarking and defoliating insects on the young shoots of the unprotected plants, was noted very early in the season. This initial and continuing impact obviously reduced production of the unprotected plants, which did not recover from this set-back through the rest of the season. These results concur with other work on the effect of continuously feeding insects on woody plant productivity. In contrast, univoltine or intermittent feeders have been shown to stimulate woody plant growth through plant compensation.

• Crop science

D.5411/30/1/3:

VELD: GROWTH PATTERNS OF *ACACIA KARROO* IN THE CENTRAL GRASSVELD OF THE EASTERN CAPE. 1986-1987

W.R. Teague

The shoots of *Acacia karroo* appear to be formed by free growth. This involves the simultaneous initiation and elongation of new stem units. These shoots are heterophyllous since they do not appear to be fully preformed in the bud stage and produce both early and late leaves. Once initiated, shoots appear to develop as and when environmental conditions are conducive to growth.

The degree of development, apparently, is governed by their position in the canopy and on each branch and shoot. They have the potential to be evergrowing, in that shoot and leaf initiation and expansion can take place during the whole season, depending on environmental conditions.

These observations have identified at least six phenophases in the annual growth cycle of *Acacia karroo*. These are:

- (i) dormant phase
- (ii) early flush
- (iii) pre-reproductive phase
- (iv) reproductive phase
- (v) post-reproductive phase and
- (vi) pre-dormancy phase

As predicted, growth of *A. karroo* plants in the juvenile phase is more vigorous than at any other. However, these plants are more susceptible to drought. Similarly, large plants are less productive than medium sized ones, except under drought conditions. In both circumstances, this is assumed to be due to the smaller plants in either case having a less well-developed root system, making them more susceptible to the drying out of moisture in the upper soil layers.

D.5411/30/1/4:

VELD: THE EFFECT OF DIFFERENT INTENSITIES OF DEFOLIATION AT DIFFERENT PHENOLOGICAL STAGES ON THE AERIAL GROWTH OF *ACACIA KARROO* IN THE CENTRAL GRASSVELD OF THE EASTERN CAPE. 1986-1987

W.R. Teague

Both leaf and shoot growth of *A. karroo* plants were stimulated following defoliation by goats, and there was a strong interaction between the intensity and the phenophase at which defoliations were effected. Plants were very sensitive to defoliation in the early flush phenophase, where the 25 % defoliation resulted in the highest leaf and shoot production. As the season progressed, the degree of defoliation which resulted in maximum production, increased. Thus, when plants were defoliated at the pre-reproductive phenophase, the 50 % and 75 % defoliations resulted in the highest leaf and the highest shoot production. The same result was measured following defoliation in the post-reproductive phenophase. In the pre-dormancy phenophase, only the most severe defoliation (100 %) resulted in any stimulation of new growth.

Following defoliation early in the season, leaf masses took almost seven months to plateau, compared to 5 and 3 months following the defoliations at the pre-reproductive and the post-reproductive phenophases, respectively.

Measurements of leaf and shoot growth in the season following that during which defoliations were effected, indicated that the stimulation effect was carried through to the following season. This only applied to plants defoliated in the growing period. Plants defoliated in the dormant winter period were not stimulated at all.

Acacia karroo plants that were defoliated by hand showed no significant growth stimulation relative to undefoliated control plants in contrast to the large stimulation measured, following comparable defoliation by goats.

D.5411/30/1/5:

VELD: THE EFFECT OF DIFFERENT FREQUENCIES AND INTENSITIES OF DEFOLIATION UNDER WET AND DRY MOISTURE REGIMES ON AERIAL GROWTH OF *ACACIA KARROO* IN THE CENTRAL GRASSVELD OF THE EASTERN CAPE. 1986-1987

W.R. Teague

Defoliation by goat activates *Acacia karroo* in such a manner that successive defoliations can result in this activation being additive. Thus 25 % defoliation at 2-week intervals accumulated more than undefoliated control plants. Similarly 75 % defoliation every 8 weeks accumulated leaf more rapidly than plants defoliated the same amount only once that season.

There is clearly a defoliation level below which *A. karroo* plants are not activated. Activation appears to be negated to a degree by defoliation at 2-week and 4-week intervals relative to that at 8-week intervals. Since a 12-week frequency of heavy defoliation produced less than the same defoliation at 8-week intervals, defoliation activation appears to have declined after an interval exceeding two months.

The activation following defoliation at 75 % was strong enough to result in the 2-week frequency producing as well as the 4-week and the 12-week frequency defoliations at the same level.

The more frequently the plants were defoliated, the more carbohydrate reserves dropped. However, these plants appeared to adjust to cope with the very frequent defoliations. There was no connection between leaf accumulation and carbohydrate levels following different frequencies of defoliation. Although reserve

levels of the more frequently defoliated plants dropped significantly, leaf production was at least as high as that of the undefoliated control plants.

• *Water requirements*

D.5411/31/1/2:

VELD: WATER STRESS AND GROWTH OF *ACACIA KARROO* IN THE CENTRAL GRASSVELD OF THE EASTERN CAPE. 1986-1987

W.R. Teague

The general pattern of growth and the phenophases are not changed by water stress. Rather, the initiation, emergence and development of shoots and leaves is governed by how favourable environmental conditions are. Thus, moisture stress merely slows down growth. If there is not much growth in an earlier part of the season, the plants can partially compensate by producing more leaf per unit of shoot if environmental conditions improve.

African *Acacia* spp. have been documented as having a conspicuous late, dry season flush before significant rains have fallen. The first rain after this flush that saturates the soil, stimulates an immediate growth of shoots. In this study, *A. karroo* produced leaf and shoot if there was subsoil moisture available to the plants. Where there was no moisture, as measured by down shoot water potentials, no growth was observed before rains had fallen. It is probable, therefore, that flushes of any magnitude that occur in these cases, are both dependent on and proportional to, the amount of soil moisture available to these plants.

• *Potential studies*

T.5411/36/2/2:

AN OESOPHAGEAL FISTULA SAMPLE INVESTIGATION OF PLANT SPECIES SELECTION ON VELD PASTURES IN THE SOUTH-EASTERN TRANSVAAL. 1985-1988

J.H. Roos

The object of these studies was to describe the epidermal and transverse section characteristics of certain Southeastern Transvaal grasses. A thorough description of the species, and the compilation of a key is an aid to the later identification of small grass segments obtained from oesophageal fistula samples of cattle and sheep. This is an integral part of a comprehensive study on the selection habits of grazing animals on sourveld.

Twenty nine species were described according to the epidermal and transverse section characteristics, and attention was given to the following:

- the width of the costal zones;
- the shape and axial length of the silica-bodies;
- the shape of the costal long-cells, and the extent to which the cell-walls are sinuous;
- the width of the intercostal zones;
- the occurrence and axial length of stomata, and the shape of the subsidiary cells;
- the shape and axial length of the intercostal long-cells, and the occurrence of short-cells and silica-cells between the long-cells;
- the occurrence of prickly-hairs, macro-hairs, micro-hairs and papillae on the epidermis;
- the occurrence of ribs and grooves;
- the occurrence of a midrib and whether or not it occurs in a keel and where it is associated with a keel the occurrence of other vascular bundles in the keel is also described;
- the occurrence of bundle-sheaths, and whether they are associated with abaxial and adaxial interruptions;
- the occurrence and shape of abaxial and adaxial sclerenchyma, and the width in relation to that of the vascular bundles; and
- the different forms of bulliform cells.

All the species could be distinguished according to these characteristics. A key was compiled with the aid of these characteristics as a further aid to the identification of the species. It was established that these species could be positively identified in the oesophageal fistula samples of cattle and sheep.

Certain characteristics reveal minor quantitative and qualitative variations, but these do not affect the ease with which species can be identified.

- *Management*

T.5411 41 1'3:

VELD: RESIDUAL EFFECTS OF DIFFERENT INTENSITIES AND PERIODS OF
UTILISATION OF THE VIGOUR OF THE MORE PALATABLE GRASS SPECIES IN
SOURVELD. 1986-1988

D.L. Barnes

Patterns of shoot growth

Seven defoliation treatments involving grazing at three-week intervals with sheep until mid-January or mid-March, or for the whole growing season, at each of two stocking rates, or resting for the whole growing season, were applied on veld during the 1985-86 season. Patterns of growth of the shoot components, green leaf, dry leaf and stem plus inflorescence of populations of tufts of the three most abundant grass species, *Heteropogon contortus*, *Themeda triandra* and *Trachypogon spicatus*, were determined on a mass per unit tuft basal area basis during the periods of rest. Relative utilisation was estimated by observations on samples of tufts after each grazing occasion.

Within treatments, growth patterns during rest periods of the populations of the three species were broadly similar, though production per unit tuft basal area decreased in the ratio 100:65:40 for *Trachypogon*, *Themeda* and *Heteropogon*, respectively. Using the cumulative growth curves, absolute and relative growth rates for the whole shoot and green leaf in certain of the treatments were established.

A pervasive feature of the growth patterns was a tendency towards senescence in the latter half of the growing season. Defoliation by grazing was only partially effective in delaying this process. Amounts of herbage of each species which were present at the start of the rest periods beginning in mid-January and mid-March were generally proportional to the stocking pressure prior to the rest. However, there was a poor correlation between this result and estimated relative utilisation.

Residual effects on vigour

Seven defoliation treatments involving grazing at intervals with sheep until mid-January or mid-March, or for the whole growing season at each of two stocking intensities, or testing for the whole growing season (control treatment), were applied on veld during the 1985/86 growing season. Residual effects of the treatments on root mass and the mass of non-structural carbohydrates (NSC) in the roots of populations of the three most abundant grass species, *Heteropogon contortus*, *Themeda triandra* and *Trachypogon spicatus* were determined in the winter of 1986.

Shoot yields in the 1986/87 growing season were measured by harvesting species separately on both a tuft basal area and quadrat basis. In general, the defoliation treatments resulted in marked reductions in root and NSC mass in all species as compared with the control.

Residual effects on shoot yields were relatively small, and, in sharp contrast to previous findings, correlations between effects on roots and on shoot yields were, except in the case of *Trachypogon*, generally poor. Discrepancies were found between the residual effects on shoot yields of species measured on a per unit tuft basal area or a quadrat basis. The implications of such discrepancies are discussed.

CULTIVATED PASTURES

- *Nutrition*

CULTIVATED PASTURES: NITROGEN CYCLING IN CULTIVATED PASTURES IN THE
EASTERN SEABOARD OF THE EASTERN CAPE. 1982-1985

J.E. Danckwerts

The methodology described in this report was adequate for the type of work undertaken except for that used to measure denitrification. The methods used were too insensitive to detect the small quantities of N denitrified. The use of more expensive technology available in electron capture gas chromatography would enable the small amounts of N lost to be measured.

The recovery of NO_3^- N in soil and plant samples by various modifications of the Kjeldahl method was investigated. The standard reduced iron and salicylic acid modifications of the method were found to be acceptable, but lengthy and involved procedures. A very simple method was devised to recover NO_3^- N from dry soil and plant samples. The method involves the addition of a small amount of a phenolic compound, such as phenyl acetate, to the sample before the digestion procedure is begun. Recovery of all NO_3^- N using this modification is quantitative provided the sample is dry.

It is generally accepted that NO_3^- N in soil and plant material is not recovered quantitatively by the Kjeldahl method and that some modification is required to recover this N. This was shown to be true in the case of plant material but not in the case of soil. In soils containing less than about $200 \mu\text{g NO}_3^- \text{ N g}^{-1}$ soil, recovery of NO_3^- N by the standard Kjeldahl technique was found to be quantitative.

Analyses of soil samples carried out by an independent laboratory using an auto-analyser suggested that the total soil N concentration varied considerably with respect to time. These results were unexpected in terms of what is known about total soil N, which is generally regarded to be very stable. A subsequent investigation revealed that the auto-analyser is too sensitive an instrument to use for total N determinations. This is because of the errors that may occur in the process of diluting the sample into the range that can be measured by the auto-analyser. It is believed that these dilution errors were responsible for creating the impression of variability with time.

Total N concentrations in soils from both the Sarnia and Ebenezer farms, as measured by the laboratory at UPE, were found not to fluctuate significantly over a period of one year.

A slight, non-significant trough in total soil N concentration was observed in the Sarnia soil which can be attributed to plant uptake of fertiliser N.

Ammonia volatilisation experiments carried out in flasks without plants showed that ammonia volatilisation did not occur from either soil at the normal pH of the soil. Volatilisation did occur when the soil pH was increased to above 7.0. These results suggest that ammonia volatilisation is unlikely to be an important mechanism of N loss from these soils.

Long-term ammonia volatilisation experiments carried out in pots with and without plants showed that ammonia volatilisation can occur. About 24 % of the applied fertiliser N was lost from the soil from the farm Sarnia by ammonia volatilisation in the first four weeks after fertiliser application. The reason why ammonia volatilisation did not occur in the flask experiments is probably because the soils in the flasks were maintained at a constant water content and relatively low temperature. Such conditions are not conducive to ammonia volatilisation.

N mineralisation proceeded more rapidly in soil from the Ebenezer farm compared to soil from the Sarnia farm. However, more N was mineralised in the Sarnia soil than the more loamy Ebenezer farm soil. This is probably as a result of the management and histories of the two soils.

Nitrate N was readily leached from both these farm soils indicating that this could be an important potential mechanism for N loss. However, rainfall in the Humansdorp and Palmietvlei areas is of such a nature that losses by leaching are unlikely to be important except in exceptional circumstances. The times at which leaching losses are likely to occur would be immediately after fertiliser application and before the plants had established themselves.

No native or added fertiliser NH_4^+ was found to be fixed by either soil.

Laboratory experiments designed to examine denitrification in the two soils revealed that denitrification did not occur except under completely anaerobic conditions.

Denitrification could not be quantitatively measured by analysing the amount of N_2O lost from the soil as even in the presence of acetylene N_2O was reduced to N_2 .

Losses of fertiliser N occurred in fertilised pots containing plants. These losses occurred after plant senescence and can only be attributed to denitrification. The decomposing root material probably led to the development of anoxic microzones in the soil and in addition provided the denitrifiers with an excellent source of organic material.

Inorganic N was found to be taken up very rapidly by the plants, the amount taken up being greatly in excess of immediate requirements. An implication of this is that the potential for leaching is reduced as the inorganic N is removed from the soil and located in the plants. However, the accumulation of high concentrations of NO_3^- in the plant material can be a potential problem to farmers and could result in the poisoning of cattle. The inorganic N fertiliser must be applied to the soil at such a rate as to ensure that plant uptake and accumulation of NO_3^- is not excessive. Fertiliser N can also be wasted as much of the NO_3^- taken up and stored is still present in the plant as NO_3^- at senescence.

Nitrate reductase activity (NRA) was found to underestimate the amount of N as NO_3^- being incorporated into the plants. However, NRA was not measured in the root material which was greater in biomass than the shoot material and could have contributed significantly to the reduction of NO_3^- . NRA was found to be an excellent indicator of plant metabolic activity.

- N.5413/05/1/1: CULTIVATED PASTURE: PHOSPHATE AND LIME NUTRITION OF *TRIFOLIUM/FESTUCA* PASTURE ON DYSTROPHIC SOILS IN BIOCLIMATE 3 OF THE HIGH RAINFALL SOURVELD AREAS OF NATAL. 1979-1981
- N.5413/05/1/2: CULTIVATED PASTURE: PHOSPHATE AND LIME NUTRITION OF *TRIFOLIUM* PASTURE ON DYSTROPHIC SOILS OF BIOCLIMATE 3 OF THE HIGH RAINFALL SOURVELD AREAS OF NATAL. 1979-1982
- N.5413/05/1/6: CULTIVATED PASTURE: *PENNISETUM CLANDESTINUM* RESPONSE TO N, P AND LIME ON HIGHLY WEATHERED SOILS IN THE HIGH RAINFALL SOURVELD AREAS OF NATAL. 1980-1985
- N.5413/05/1/8: CULTIVATED PASTURE: RESPONSE OF KIKUYU TO N, P AND LIME ON HIGHLY LEACHED SOILS IN THE HIGH RAINFALL SOURVELD AREAS OF NATAL. 1982-1986
- N.5413/05/1/10: CULTIVATED PASTURE: RESPONSE OF WHITE CLOVER TO P, K AND LIME ON A HIGHLY LEACHED SOIL IN THE HIGH RAINFALL SOURVELD AREAS OF NATAL. 1983-1984

N. Miies

The responses of kikuyu (*Pennisetum clandestinum*), tall fescue (*Festuca arundinacea*) and white clover (*Trifolium repens*) to lime and fertiliser treatments were studied in field factorial trials at Tabamhlope and Cedara Research Station. The trials were located on acid highly weathered soils (Balgowan, Balmoral, Farmhill, Griffin and Cleveland series). Dry matter production, herbage nutrient levels and chemical properties of topsoils (0-100 mm) were monitored. The main findings summarised here are discussed in more detail in the publications dealing with various aspects of this work.

Species differed widely in their responses to lime. The yields of the temperates, white clover and tall fescue, increased sharply with lime additions which commensurate with the elimination of the bulk of exchangeable Al (pH 5.0). Further increases in pH resulted in yield depressions which could be overcome by high rates of P fertiliser. It is noteworthy, however, that such lime-induced yield depressions were restricted to the first season following pasture establishment. Relationships between yield and soil acid saturation for these temperate species indicated that acid saturations in excess of 10 to 15% severely curtailed dry matter production. In contrast, lime additions had little effect on the dry matter production of kikuyu, with near maximum yields of this grass being realised at acid saturations of 50% or more.

With the soils on which these studies were undertaken having low native P reserves and high P fixation capacities (therefore being representative of most upland well-drained soils in the Natal Midlands), large yield responses to applied P were measured. The P requirement for maximum yield varied widely over the soils and also with the species propagated. Maximum requirement was indicated on the high clay content (50%-60% clay in the topsoil) Mistbelt soils, where up to 430 kg P/ha was required for optimum growth of white clover. Phosphorus interacted positively with applied N in its effects on kikuyu yields on the virgin Mistbelt soils. Responses to applied P were consistently at a maximum during pasture establishment and, in the case of kikuyu, in the early part of the growing season. Yield response to P was closely related to P extractable from the soil with a solution consisting of 0.25 M NH_4HCO_3 + 0.01 M EDTA + 0.01 M NH_4F , adjusted to pH 8.0. Critical soil test values using this extractant were derived for the various species. Sorption isotherms failed to reflect meaningful (in terms of dry matter yield) differences between soils with respect to their P status. Internal (plant) P requirement for maximum yield varied between species, and for individual species, varied over the season. These findings emphasise the need for caution in the use of plant analyses for predictive purposes.

Dry matter production data were frequently characterised by significant lime P interactions. Positive lime P interactions, noted in the yields of white clover soon after establishment, as well as in the spring/early summer growth of kikuyu, appeared to be restricted to conditions of severe P deficiency. Negative lime P interactions, considered to be of practical significance, occurred at more favourable levels of P supply. In general, herbage P concentrations increased with increases in soil pH.

Yield responses to applied N were closely related to moisture supply. The optimum N rate of kikuyu in these cutting trials ranged from 400 to 600 kg/ha/annum, with the lower figure in this range being indicated in seasons of relatively poor rainfall. In the initial season following kikuyu establishment on virgin soils, appreciable yields in the absence of applied N reflected high N reserves in these soils. This indicates that in newly established pastures on virgin land, mineralisation of soil organic N may significantly reduce fertiliser N requirements in the short-term. Negative lime N interactions in yield data was evidence of the stimulation of soil organic N mineralisation by liming.

Large yield responses to applied K, particularly under high N fertilisation regimes, were noted. Diminished response to applied K under limiting levels of P or high soil acidity emphasised the importance

of nutrient balance in optimising dry matter production. The rapid depletion of soil K under cutting-and-removal type management was suggestive of low non-exchangeable K reserves in the soils under study. Striking evidence of high soil K levels suppressing Ca and Mg uptake was found, with this suggesting K implication in the widely reported unfavourable Ca:P ratio in kikuyu.

V.5413/05/1/2:

CULTIVATED PASTURE: DETERMINATION OF THE NUTRIENT REQUIREMENTS OF *SPOROBOLUS FIMBRIATUS* BY MEANS OF POT EXPERIMENTS AT GLEN. 1981-1986

L.G. du Pisani

The objective of this study was to quantify the N, P and K requirements of *Sporobolus fimbriatus* under controlled conditions in a glasshouse.

Treatments consisted of four levels each of N, P and K randomised in a 4 x 4 x 4 randomised block design, with 3 replications. The N, P and K levels were:

- Nitrogen = 0; 100, 200 and 300 kg/ha, respectively
- Phosphorus = 0; 30, 60 and 90 kg/ha, respectively and
- Potassium = 0; 20, 40 and 60 kg/ha

The results obtained with the experiment can be summarised as follows:

1. *Sporobolus fimbriatus* has a relatively high N requirement, as the highest N level did not satisfy the maximum requirement.
2. The optimum P requirement was quantified as being 45 kg/ha.
3. *Sporobolus fimbriatus* reacted poorly to K, indicating that the K content of the soil was adequate for growth and production (ca. 200 mg K/kg soil).
4. It was evident that N and P should be applied at a balanced rate to have the required influence on both production and quality.
5. The grass had a favourable quality, even in the winter.

• Crop science

D.5413/30/1/3:

CULTIVATED PASTURE: MAINTENANCE AND DEVELOPMENT OF THE PASTURE NURSERY AT CLIFFORD. 1984-1987

C.J.G. le Roux

A nursery was laid out in the *Themeda-Festuca* Alpine veld to find legumes which could be used to suppress nassella in that fertile but cold and relatively low-rainfall area. Seed of fifty-four legume cultivars was planted and the cultivars were rated for vigour and other growth characteristics.

A number of annual- or short-duration perennials were rated as vigorous or very vigorous. However, it was concluded that because their re-establishment was unreliable they were not suited to suppress nassella in non-arable areas. *Vicia* spp., some *Trifolium subterraneum* and *Melilotus* cultivars were in this category. *Medicago sativa* and *Onybrichis vicaeifolia* cultivars were rated as very vigorous or vigorous, but their ability to suppress nassella is suspect. *M. sativa* is slightly sensitive to tetrapion, so that nassella cannot be treated without damaging the sward.

Of the legumes tested *Lotus corniculatus* and *Coronilla varia* seem best suited to suppressing or replacing nassella. Both are difficult to establish, but *L. corniculatus* is not affected by tetrapion, so that the sward can be sprayed repeatedly if necessary to eliminate the grass weed. *C. varia* spreads rapidly and has the reputation of being able to suppress other seedlings.

Research should concentrate on methods to establish these legumes in the area and on management strategies to enhance their ability to suppress nassella.

• Potential studies

V.5413/36/1/2:

EVALUATION OF *SPOROBOLUS FIMBRIATUS* AS A PLANTED PASTURE WITH RESPECT TO ITS PRODUCTION POTENTIAL AND QUALITY AT GLEN. 1983-1986

I.G. du Pisani

The growth cycle, total dry matter (DM) production, leaf:stem ratio, crude protein content and digestibility of *S. fimbriatus* were evaluated. The growth pattern is typical of a tropical grass species with initial growth

in spring (October), reaching maximum growth in summer (February to April), whereafter growth declines to a minimum in September.

The relative growth rate varied considerably between seasons as a result of the variation in precipitation and temperature.

On average *S. fimbriatus* produced 2,72 ton DM ha⁻¹ year⁻¹ over the experimental period, with a grazing capacity of 4,22 ha LSU⁻¹ year⁻¹. Dry matter production declined over the experimental period, mainly because of the drought conditions that prevailed and an apparent low resistance to grazing.

The leaf:stem ratio of *S. fimbriatus* varied markedly between seasons and was more favourable under a non-grazing than grazing regime. Furthermore variations in the leaf to stem ratio resulted in a utilisation percentage of available herbage ranging from 25 % to 60 %.

The crude protein content of *S. fimbriatus* selected by the grazing animal ranged between 16 % (spring) and 8 % (autumn), while the digestibility ranged from 71 % (spring) to 63 % (autumn). It is therefore concluded that, providing herbage availability is not limited, the crude protein content and digestibility of *S. fimbriatus* satisfy the nutritional requirements of the grazing ruminant.

• Management

D.5413/41/1/12:

CULTIVATED PASTURE: SCREENING OF PERENNIAL LEGUMES AT DOHNE. 1981-1986
C.J.G. le Roux

Fifteen perennial legumes were compared under dryland conditions on two sites in the Dohne sourveld. These sites were Dohne, which has a mild, but dry winter and an average rainfall of 743 mm per year, and Grasslands, which is a colder site with an average rainfall of 866 mm per year. The legumes were compared in terms of their total dry matter production and the spread of this growth during the season.

The species and cultivars which were compared were: *Trifolium repens* cv. Huia and Ladino, *T. pratense* cv. Hamua, *T. fragiferum* cv. Palestine, *T. ambiguum* cv. Summit, *T. semipilosum* cv. Safari, *Lotus corniculatus*, *L. pedunculatus* cv. Maku, *Medicago sativa* cv. S.A. Standard, *Coronilla varia* cv. Penngift, *Lepedeza cuneata*, *Nenotonia wightii* cv. Clarence and Cooper, *Stylosanthes gracilis* cv. Finestem and *Macroptilium atropurpureum* cv. Siratro. The plots were harvested at four to six weekly intervals.

At Grasslands *C. varia* produced (10,6 t/ha/a) more than *M. sativa* (7,1 t/ha/a). At Dohne *C. varia*, *M. sativa* and *N. wightii* cv. Cooper all produced more than 6 t/ha/a. The high yields and persistence of *C. varia* and *N. wightii* suggest that these two legumes can play a role in dryland pastures (as *M. sativa* should) in the Dohne sourveld. *C. varia* could also have a role to play in replacing *Stipa trichotoma*.

The monthly production of the legumes at Dohne was determined.

N.5413/41/1/5:

EVALUATION OF OF IRRIGATED RYE GRASS WITH AND WITHOUT CLOVER GRAZED BY EWES AND LAMBS AT DIFFERENT STOCKING RATES AT DIFFERENT N LEVELS IN BIOCLIMATE 4e. 1982-1987

T.M. du Plessis

The primary objective of this study was to increase net farm income in the Highland sourveld of Natal by developing pasture-based fat-lamb production systems. Secondary objectives included:

- determination of the most suitable pasture species or species mixture;
- determination of the optimum level of N fertilisation;
- establishment of biological and economic optimum stocking rates;
- projection of expected profit and
- verification of proposals on a farm scale.

Midmar Italian rye grass was compared to selected legumes alone, and in mixtures with rye grass in a small plot trial conducted over two years at a 3- and 6-week harvesting frequency under irrigation.

Rye grass in combination with red and white clover provided the highest yields for both harvesting intervals in both years. When this pasture was subsequently compared to rye grass alone under grazing, no significant difference could be detected in lamb gains at 20 and 28 ewe-lamb units/ha, but at 36 ewe-lamb units/ha the lambs on rye grass started losing mass at 30 kg, while those on rye grass + clover continued to gain until a market mass of 40 kg was achieved.

In a small plot trial little response was detected to added N above 175 kg N/ha on rye grass + clover, and under grazing, no significant difference was observed between 275; 375 and 475 kg N/ha over two

single-year periods. Relationships between average daily gain (ADG) and stocking rate, ADG and disc metre height, and stocking rate and disc metre height were mostly well described by linear functions.

Expected pre-weaning ADG was 150 g higher ($P < 0,01$) than post-weaning ADG (100 g) in the first year, and a similar difference was observed in the second year. For the period common to all stocking rates an average maximum gain/ha of 824 kg was achieved at a stocking rate of 33,5 lambs/ha and a disc metre height of 4,5 cm.

By lambing in April, lambs could be marketed in September at 40 kg and more weaned lambs could be grazed on the pasture and marketed in December, leading to an expected gain/ha of 1 400 to 2 000 kg, and expected profit/ha of R1 254 to R2 771, depending on stocking rate. When evaluated under farm conditions, this system produced 2 060 kg live mass/ha and a profit of R3 206/ha.

It is concluded from the present study that the fat lamb production system based on irrigated rye grass + clover pastures can be recommended with confidence to farmers in the Highland sourveld of Natal.

W.5413/41/1/3:

THE DETERMINATION OF THE CARRYING CAPACITY OF ESTABLISHED GRASS/LEGUME PASTURES UNDER IRRIGATION AT DIFFERENT GRAZING MANAGEMENT SYSTEMS IN THE R0ENS AREA. 1979-1987

J.M. van Heerden

The Winter Rainfall Region has a relatively large area under irrigated grass/legumes pastures. These pastures generally form part of larger fruit and wine producing farming systems. The grazing capacity, animal production potential and management requirements of these pastures have, however, never been determined. This facet was therefore executed for this purpose.

A complex irrigated grass/legume mixture consisting of the legumes: lucerne and white and red clover and the grasses: fescue, cocksfoot and perennial rye grass was evaluated at Tygerhoek Experiment Station (Riviersonderend) over a period of three years. The facet consisted of two separate parts. In the first the seasonal grazing capacity of the pasture was determined at three grazing pressures (1,5; 2,25 and 3,0 kg DM dry sheep unit⁻¹ day⁻¹) using a put-and-take system in a six camp rotational grazing system. Dry Merino sheep was used as experimental animals.

It was found that the optimum mean annual stocking rate of this pasture for maximum wool yield per hectare was 54,4 dry sheep units per hectare over the period of three years. It was also found that the seasonal grazing capacity of the pasture varied through the year and that dry matter would be most limiting during the winter, but highest during spring and summer.

In the second part of the facet the animal production potential was determined at three set stocking rates of Merino ewes lambing during September, using either a six camp rotational or a continuous grazing system.

Rotational grazing resulted in a decrease in the clover content, an increase in the grass content, the maintenance of the lucerne component and a higher grazing capacity in comparison with the continuously grazed system. The higher clover content of the continuously grazed camps resulted in a higher animal production per unit area during the first two seasons, but during the last season the animal production was highest on the rotationally grazed pastures.

LEGUME FODDER CROPS

• Crop science

T.5417/30/1/6:

LEGUME FODDER CROPS: INTERRELATION BETWEEN RESPECTIVELY, *TRIFOLIUM VESICULOSUM* AND *TRIFOLIUM SUBTERRANEUM* AND *LOLIUM MULTIFLORUM* CV. MIDMAR IN MIXTURES. 1983-1987

Marika van den Berg

The interaction of *Trifolium vesiculosum* and *Lolium multiflorum* in mixtures was measured in terms of dry matter production (DM), crude protein content and crude protein production in two field trials. The treatments included different rates of nitrogen applications and defoliation, as well as different plant densities and methods of mixing the two components. Total DM production of the different mixtures only differed slightly, particularly in the first trial. Height of defoliation had little effect on DM production, but N application tended to increase the yields of the pure grass and the mixtures, particularly in the second trial. At high N application the clover was dominated by the grass when the two species were mixed within the

rows. Alternate rows, on the other hand, ensured an appreciable percentage clover, even at the higher N application.

In contrast to DM production, crude protein content and -production of the mixtures showed strong positive response to N application; this was due to effective uptake of the fertiliser by the grass component. However, the highest protein production achieved by an application of 240 kg N ha⁻¹ to the mixtures and pure grass did not differ appreciably from the amount produced by pure clover without any N fertiliser. Mixing the grass and clover within the rows resulted in higher protein content of the grass than was the case in alternate rows.

The land equivalent ratios calculated from the data suggested that mixtures of the two components, with few exceptions, resulted in better utilisation of the land than was possible with the respective pure stands.

AGRICULTURAL PRODUCTION ECONOMY RESEARCH

Macro resource economy

STRUCTURAL STUDIES

● *Production economics*

PE.5612/48/3/4:

RESEARCH IN RESPECT OF THE FINANCIAL REHABILITATION OF FARMERS WITH LIQUIDITY PROBLEMS. 1984-1988

C.W. Mostert

A review of available literature shows that several factors are important for the successful financial rehabilitation of farmers:

- financial assistance
- technical assistance
- social assistance and
- legal assistance

Initial debt, liquidity, inflation and interest rates influence the potential financial rehabilitation of farmers with liquidity problems. The effect of several strategies to enable the firm to recover under risk-related conditions were investigated in this study.

The following financial indicators were used to measure the strategies: liquidity (current ratio), coverage (nett disposable income), solvency (debt to assets ratio) and profitability (change in nett worth).

A simulation model and analysis of variance were used to evaluate the strategies over a five-year period. Six strategies were evaluated:

0. No additional assistance (status quo)
1. Cash injection without obligation
2. Marginal crop land withdrawal and subsidised change to cultivated pastures
3. Interest subsidisation of medium- and long-term loans
4. A three-year debt repayment standstill with rescheduling
5. Debt reduction of medium- and short-term loans

Results show that the various strategies give different relative liquidity and solvency advantages. All positive strategies lead to the medium-term survival of the firm.

Income injection without obligation fares well during the assistance period, but if structural problems within the firm (for example debt structure and enterprise mix) are not rectified, the nett effect is significantly reduced. Interest subsidisation gives relieve during the initial assessment period but is rejected on grounds of it's negative influence on financial markets and the negative financing practices it causes. Debt standstill increases liquidity reasonably but decreases solvency of the firm slightly. Debt reduction proves to be effective with high debt firms; it stabilises income and reduces the possibility of bankruptcy significantly. Land withdrawal appears to influence liquidity negatively, but stabilise income after year three. This strategy is the least successful over the short term.

Farm business management

ENTERPRISE RELATIONSHIPS

• *Production economics*

PE.5623/48/2/3:

AN ECONOMIC STUDY OF ENTERPRISE RELATIONSHIPS FOR FRESH MILK PRODUCTION IN THE NATAL REGION. 1984-1987

R.J. Gordijn

This analysis of fresh milk producers in Natal deals with the most important production factors in fresh milk production. To ensure representative production functions, the Natal Region has been divided into homogenous areas. These areas include East Griqualand, Midlands and Ixopo. Data for this study were obtained from mail-in record study group records for the five-year period 1978/79 to 1982/83.

Chapter 1 deals with the economic history in the three regions. All dairy farmers are included, irrespective of dairy herd size and proportion of gross income received from dairy farming. Farmers in East Griqualand rely heavily on income from beef and sheep, apart from dairy. This spreads their labour management amongst several enterprises, resulting in the dairy being neglected. This was shown to be the case when evaluating the value of marginal product for labour which was greater than its unit cost. The other areas relied less on other enterprises to supplement their gross farm income. In all areas, the main cost items were feed and labour.

The problem related to production function analysis are discussed in chapter 2. The choice of variables is discussed and it appears that seven variables are the optimum, and four the least. Problems related to multi-collinearity, aggregation and omission of variables, errors of measurement, cross-sectional data and the sampling of data, were reviewed.

Chapters 3 to 5 analyse the three regions of Natal using a Cobb-Douglas type production function. The efficiency measures calculated give strong indications as to production quantity and practices. The value of marginal product indicated that in the East Griqualand and Midlands areas, concentrates and pastures are utilised beyond their respective economic optimum. The over-utilisation of pastures can be attributed to wastage or under-stocking in summer. In the Natal Midlands labour appears to be over-utilised, while in the other areas labour use needs to be increased.

The production elasticities of inputs of all areas show that the variable "number of cows" has the highest coefficient followed by "concentrates" in the East Griqualand and Midlands areas and "forages" in the Ixopo area.

In calculating the profit maximising combinations for the smallest geometric mean and largest herd sizes in the samples, the mean milk production per cow was increased in the East Griqualand and Ixopo areas by 45 % and 11 %, respectively, i.e. from 3 526 litres to 5 129 litres per cow in East Griqualand and from 4 573 litres to 5 077 litres per cow at Ixopo. For the Natal Midlands, litres milk per cow and feed expenses decreased but still gave higher profits.

The last section of each area analysed discusses the marginal costs of output in conjunction with various inputs. The assumption that profits are maximised when marginal costs equal marginal revenue, applies under conditions of perfect competition.

Because the market in which the dairy farmer operates is not perfectly competitive, factors such as lack of information, risk and constraints on inputs give rise to farmers who are considered to be rational decision makers, not allocating inputs according to the theoretical optimum.

An attempt was made in chapter 6 to pool all the data which were analysed. However, with the use of dummy variables for testing intercepts and slopes, it was found that the three regions are significantly different from each other.

PE.5623/48/4/4:

RESEARCH IN RESPECT OF THE ECONOMIC ADVANTAGE OF CONSERVATION TILLAGE IN THE SUMMER CROPPING AREA OF WESTERN TRANSVAAL. 1983-1987

J. Hough

Data on yield, machinery and tillage cost have been used as basis to compile different budgets on two tillage systems (conventional and conservation) over two years. Comparisons have been made in respect of gross income, direct allocatable cost, gross margin, nett farm income and farm profit. The effect of tractor size

machinery cost and capital investment and the capital effect of changing to the more economical system have also been evaluated.

This research showed that conservation tillage is more economical than conventional tillage in respect of yield, fuel, repairs and maintenance, depreciation, regular machinery labour and interest on machinery capital. This gave rise to relatively decreasings of 10,30 % in the gross income, 47,59 % in the nett farm income and 62,83 % in the farm profit of the conventional system.

No important influence of tractor size on machinery cost have been noticed at 500-750 hectares. There are significant differences in capital investment between the two systems at 500-750 hectares and the positive capital connection between larger tractors and conservation tillage have been confirmed. This positive connection is also more significant at larger areas.

An additional amount of R35 per hectare in the first year would be necessary to change from conventional to conservation tillage. However, the total advantage of conservation tillage would cover this expenditure.

ENTREPRENEUR DEVELOPMENT

PROGRAMMED EXTENSION

Resource utilisation

STOCK AND GAME FARMING

• Persuasion

V.6211/39/3/1:

THE DETERMINATION OF PSYCHIC FIELD FACTORS WHICH HAVE AN INFLUENCE
ON THE APPLICATION OF VELD MANAGEMENT SYSTEMS. 1985-1986.
G.P. Nel

The reasons for non-adoption of improved farming practices must, to a certain extent, be sought in the intricacies of human nature. A person's attitude is furthermore determined by his perceptions. For this reason the perceived attributes of an innovation as described by Rogers and Shoemaker (1971) were determined for the application of group-three-camp grazing systems in the Zastron extension ward.

A ten per cent ($n = 38$) at-random-selected sample of stock farmers in the Zastron and Rouxville magisterial districts were personally interviewed by means of a structured schedule.

In this study adopters and non-adopters of a group-three-camp grazing system were compared as far as trialability, observability, complexity, compatability and relative advantages of the innovation was concerned.

The findings can best be illustrated by means of a table.

It was found that non-adopters have grave misconceptions as far as condition of their natural veld, both qualitatively and quantitatively, knowledge of and application of a grazing system are concerned.

It was also found that there is a vast difference between the total area under perennial pastures, viz lucerne as far as adopters and non-adopters are concerned (221 hectares versus 49 hectares). Adopters are adamant that lucerne under dryland conditions is essential for continuous application of a group-three-camp grazing system.

Rogers and Shoemaker (1972) stated that a person's perception of an innovation plays a vital role when adoption/rejection as such is concerned. The change agent should thus be well aware of the attributes of the innovation group-three-camp grazing system as perceived by adopters and non-adopters. He should also be aware of the so-called "field factor theory" as described by Lewin (1951) when planning a communication programme aimed at promoting the application of group-three-camp grazing systems in the Zastron Extension Ward.

TABLE 1 - Comparison between adopters and non-adopters as far as direction and intensity of the perceived attributes of the innovation group-three-camp grazing system are concerned

Attribute	Number of aspects examined	Mean perception: adopters		Mean perception: Non-adopters At random selected ($n = 35$)
		Control ($n = 9$)	At random selected ($n = 3$)	
Compatability	10	+1,55	+1,20	+0,35
Complexity	2	+1,80	+1,75	+0,75
Observability	17	+1,74	+1,50	+1,17
Trialability	2	-1,70	-1,75	+1,00
Relative advantage	27	+2,05	+2,02	+1,26

BOTANY

BOTANY RESEARCH

FLORA

- *Taxonomy*

PL.7111/01/1/11:

FLORA OF SOUTHERN AFRICA: MESEMBRYANTHEMACEAE - RUSCHIINAE. 1978-1988
H.F. Glen

A numerical taxonomic study of some 500 described species in the genus *Ruschia* and its allies was undertaken with the intention of producing a fascicle of the *Flora of southern Africa*. It was found that far too many taxa have been described in this group, and considerable reduction and simplification here is still necessary. In this respect, the subtribe Ruschiinae is no different from other recently revised groups in the family Mesembryanthemaceae, where there are on average between four and five synonyms per accepted species. An interesting fact to emerge from a peripheral part of this study undertaken together with Dr G.E. Gibbs Russell is that the ratio of synonyms to species is almost the same in grasses and Mesembryanthemaceae.

The data gathered in the course of this research have been preserved, and it seems possible that there may be further publications in the future.

FOREST

- *Ecology*

PL.7121/27/1/1:

VEGETATION STUDY OF THE ZULULAND COASTAL DUNES, INCLUDING FOREST,
BETWEEN RICHARDS BAY AND MLALAZI LAGOON. 1980-1987
P.J. Weisser

The aims of this study were to gather information on the vegetation and natural features of the dune area between Richards Bay and Mlalazi Estuary, to assess the desirability of dune mining, to identify areas as suitable and unsuitable for mining in terms of nature conservation, to gather baseline data on plant cover for vegetation monitoring, and to provide guidelines for dune rehabilitation.

Six 1:10 000 vegetation maps based on aerial photographs (1976) were drawn and used to assess conservation priorities with special reference to proposed dune mining. The information was summarised on three conservation-priority maps (1:25 000). The maps revealed that most of the area is covered by third-priority vegetation and no major objection to mining exists if a few areas are excluded from mining.

First-priority areas were found in the Richards Bay area, at the Mlalazi Estuary Peninsula, some scattered patches along the landward limit of the study area and along the coast. Most of these areas are already excluded from the prospecting lease. The suggestion that a KwaZulu Botanical Garden be established and that the northern dune forest and adjacent patches of hygrophilous forest be incorporated into the Richards Bay Sanctuary area deserves urgent attention.

SCIENTIFIC ARTICLES
WETENSKAPLIKE ARTIKELS

PLANT PRODUCTION PROMOTION PLANTPRODUKSIEBEVORDERING

AGRONOMY RESEARCH/AKKERBOUNAVORSING

Summer grain/Somergraan

MAIZE/MIELIES

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ANIMAL PRODUCTION PROMOTION DIEREPRODUKSIEBEVORDERING

ANIMAL PRODUCTION AND ANIMAL PRODUCTS RESEARCH DIEREPRODUKSIE- EN DIEREPRODUKTENAVORSING

Animal production/Diereproduksie

BEEF CATTLE/VLEISBEESTE

- *Nutrition/Voeding*

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MEAT/VLEIS

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VIRUSES/VIRUSSE

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HIGHLY CONTAGIOUS VIRUSES/HOOGS AANSTEEKLIKE VIRUSSE

• Virology/Virologie

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Poultry and fish diseases/Pluimvee- en vissiektes

POULTRY PLUIMVEE

• Pathology/Patologie

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Bacterial investigations/Bakteriese ondersoeke

BACTERIA/BAKTERIEë

• Pathology/Patologie

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- DE LANGE, J.F., GUMMOW, B., TURNER, G.V. & REDMAN, A.R., 1987. The isolation of *Leptospira interrogans* serovar *pomona* and related serological findings associated with a mixed farming unit in the Transvaal. *Onderstepoort Journal of Veterinary Research* 54, 119-121.
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Protozoal investigations/Protosoa-ondersoeke

PROTOZOA/PROTOSOA

• Pathology/Patologie

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Molecular biological investigations Molekulêre biologiese ondersoeke

MACRO-MOLECULES/MAKROMOLEKULE

• Protozoology/Protosoölogie

- PETRICK, H.A., AMBROSIO, R.E. & HOLZAPFEL, W.H., 1988. The isolation of a DNA probe for *Lactobacillus curvatus*. *Applied and Environmental Microbiology* 54, 405-408.

• Pathology/Patologie

- AMBROSIO, R.E., VISSER, E.S., KOEKHOVEN, Y. & KOCAN, K.M., 1988. Hybridization of DNA probes to *A. marginale* isolates from different sources and detection in *Dermacentor andersoni* ticks. *Onderstepoort Journal of Veterinary Research* 55, 227-229.

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Biochemical investigations/Biochemiese ondersoeke

BIOCHEMICAL INVESTIGATIONS/BIOCHEMIESE ONDERSOEKE

- *Physiology/Fisiologie*

GUMMOW, B. & BEYERS, F., 1988. The use of enzyme profiles in the training and racing of horses: a review. *Journal of the South African Veterinary Association* 59(4), 213-214.

- *Virology/Virologie*

VAN DIJK, A.A. & HUISMANS, H., 1988. *In vitro* transcription and translation of bluetongue virus in RNA. *Journal of Genetic Virology* 69, 573-581.

HALL, S.J., VAN DICK, A.A. & HUISMANS, H., 1989. Complete nucleotide sequence of gene segment 8 encoding non-structural protein NS2 of SA bluetongue virus serotype 10. *Nucleic Acids Research* 17, 457.

Chemical pathology and poison chemistry Chemiese patologie en gifstofchemie

POISONS/GIFSTOWWE

- *Toxicology/Toksikologie*

VAN HEERDEN, F.R., VLEGGAAR, R. & ANDERSON, L.A.P., 1988. Structure elucidation of thesiuside, a bufadienolide glycoside from *Thesium lineatum*. *South African Journal of Chemistry* 41(2), 39-41.

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AGRICULTURAL RESOURCE UTILISATION LANDBOUHULPBRONBENUTTING

RESOURCE RESEARCH/HULPBRONNAVORSING

Primary resources/Primêre hulpbronne

SOIL/GROND

- *Soil science/Grondkunde*

- BESSINGER, F., 1989. Determination of boron in soil and plant extracts - introduction of an ethanol extraction method, *SIRI Information Bulletin* No. D7.
- BOTHA, A.D.P. & JOHNSON, J.C., 1988. A vacuum filtration and leaching method for the colorimetric determination of ammonium and nitrate nitrogen in soils. *South African Journal of Plant and Soil* 5(4), 196-199.
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WATER

- *Water requirements/Waterbehoefes*

- KORENTAJER, L. & BERLINER, P.R., 1988. Effects of moisture stress on nitrogen fertiliser response in dryland wheat. *Agronomy Journal* 80(6), 977-981.
- NEL, A.A., 1988. 'n Vergelykende studie vir besproeiingskedulering by koring. M.Sc.(Agric.), Univ. Pretoria.
- WALKER, S., 1988. Spatial pattern of leaf growth of sorghum as affected by water stress and implications for canopy development. Ph.D., Univ. California.

- *Soil science/Grondkunde*

- LAND TYPE SURVEY STAFF, 1988. Land types of the map 2830 Richards Bay. *Memoirs of the Agricultural Natural Resources of South Africa* No.11.
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- McLAUGHLIN, M.J., 1988. A comparison between short-term chemical and biological methods to measure phosphorus availability in sludge - amended sesquioxides soils. *South African Journal of Plant and Soil* 5(3), 137-141.

CLIMATE/KLIMAAT

- *Meteorology/Weerkunde*

- HUMAN, N.B., SCHOLTZ, A. & WELGEMOED, C.P., 1988. Direction and frequency of damaging wind in the citrus producing areas of the Republic of South Africa. *Applied Plant Science* 2(2), 72-76.

- *Agrohydrology/Agrohidrologie*

- BEKKER, M.J., 1989. Reënvalsiklusse - interessante gegewens. *Die O.T. Kaner* 32(5), 76-77.

Surveys and demarcation/Opnames en afbakening

SOIL SURVEYS/GRONDOPNAMES

- *Soil science/Grondkunde*

- DOHSE, T.E., VAN DER WALT, M. & BARROW, S.N., 1988. Processing of field data. In: Land types of the map 2830 Richards Bay. *Memoirs of Agricultural and Natural Resources of South Africa* No. 11.
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RESOURCE UTILISATION RESEARCH (CROPS) HULPBRONBENUTTINGSNAVORSING (GEWASSE)

Summer grain/Somergraan

MAIZE MIELIES

- *Physiology/Fisiologie*

- BENNET, R.J. & BREEN, C.M., 1989. Towards understanding root growth responses to environmental signals: the effect of aluminium on maize. *South African Journal of Science* 85, 9-12.

GRAIN SORGHUM GRAANSORGHUM

- *Management/Bestuur*

- BEUKES, D.J. & KOTZE, A., 1988. Produksiepraktyke vir graansorghum op turfgronde. *Hoëveldfokus* 2 88.

Small grain/Kleingraan

WHEAT/KORING

- *Management/ Bestuur*

AGENBAG, G.A., 1987. Invloed van grondbewerking op grondfaktore en die gevolglike ontwikkeling en opbrengs van koring in die Swartland. Ph.D.-tesis, Universiteit van Stellenbosch.

Protein and oil seeds/Protein- en oliesade

SUNFLOWERS/SONNEBLOMME

- *Crop science/Grondkunde*

VAN DER MERWE, S.P., 1988. Die invloed van plantpopulasie en rywydte op die groei en ontwikkeling van sonneblom (*Helianthus annuus* L). M.Sc. (Agric.)-verhandeling, Universiteit van die Oranje Vrystaat, Bloemfontein.

SOYBEANS/SOJABONE

- *Nutrition/Voeding*

LAUBSCHER, P.J., 1988. Fosfaatvoeding van sojabone. *Hoëveldfokus* 2/88.

Other agronomy crops/Ander akkerbougewasse

SUNDRY AGRONOMY CROPS/DIVERSE AKKERBOUGEWASSE

- *Nutrition/Voeding*

VAN GELDER, H.H.M., 1988. Stikstofbestedingspeile op olieproduksie en kwaliteit van *Mentha piperita* L. *Toegepaste Plantwetenskap* (In druk.)

Vegetables/Groente

TOMATOES/TAMATIES

- *Physiology/Fisiologie*

BENNET, R.J., 1989. The effects of 2,4-D iso-octyl ester ioxynil herbicide in the liquid and vapour phases on the growth of tomato (*Lycopersicon esculentum* Mill.) plants. *South African Journal of Plant and Soil* 6, 24-31.

RESOURCE UTILISATION RESEARCH (ANIMALS) HULPBRONBENUTTINGSNAVORSING (DIERE)

Ruminants/Herkouers

LARGE STOCK/GROOTVEE

- *Nutrition/Voeding*

- DE BEER, A.S., 1988. Plantspesievoorkeure van vleisbeeste in die Hoëveldstreek onder 'n stelsel van beheerde selektiewe beweiding. M.Sc.-verhandeling, Universiteit van Pretoria.
- DE BROUWER, C.H.M., 1988. The influence of an inoculant on the fermentation characteristics of maize, grain, sorghum, forage sorghum and sunflower silage. M.Sc. dissertation, University of the Orange Free State, Bloemfontein.
- ROTHAUGE, A., LADEMANN, E.E. & DE BRUIN, G.D., 1989. Utilisation of two bush species in maintenance rations of steers. Kongres van Suid-Afrikaanse Vereniging vir Diereproduksie, 28.
- VENTER, J.P., 1988. Die aanwending van natriumbikarbonaat in die kalfdiëte. M.Sc.-verhandeling, Universiteit van die Oranje-Vrystaat, Bloemfontein.

- *Upgrading/Veredeling*

- SMITH, A., PAUW, D.A. & WILKE, P.I., 1987. Invloed van geboortemassa op die voorkoms van distokie in die Noord-Transvaalse bosveld. *Suid-Afrikaanse Tydskrif vir Veekunde* 18(4), 168-171.

- *Management/Bestuur*

- CONRADIE, J.G., 1987. 'n Bepaling van die voorkoms en beheer van mastitis by melkkoeie in die Winterreënstreek. Ph.D. (Agric.)-proefskrif, Universiteit van die Oranje-Vrystaat, Bloemfontein.

SMALL STOCK/KLEINVEE

- *Physiology/Fisiologie*

- BADENHORST, M.A., 1989. Die invloed van ouderdom op die veseldikte van Merinoramme. *Karooveld Merinoklub Herfsjoernaal*, 23.

- *Reproduction/Reproduksie*

- VAN NIEKERK, F.E., 1988. Die invloed van sekere makro- en mikrominerale op reproduksie en sekere aspekte van produksie by skape. Ph.D.(Agric.)-proefskrif, Universiteit van Stellenbosch.

- *Nutrition/Voeding*

- BEKKER, M.J. & VAN DER WALT, J.H., 1988. Sojabone en voerkalk as voerkomponente in lamrantsoene. *Rooivleis*, 4(6), 18.
- BEKKER, M.J. & VAN ZYL, W.F.J.J., 1989. Sojabone en lupine as proteïenbron vir lammers. *Rooivleis* 5(4), 32.
- BEKKER, M.J. & VAN ZYL, W.F.J.J., 1989. Evaluering van proteïen- en energierike grane as winteraanvullings vir wolskape op suurveld. Kongres van Suid-Afrikaanse Vereniging vir Diereproduksie, 28.
- BRAND, A.A. & CLOETE, S.W.P., 1988. Die benutting van ureumaangevulde en verskillende tipes geammoniseerde garsstrooi by skape. *Suid-Afrikaanse Tydskrif vir Veekunde* 18, 118-122.

- RAND, A.A., CLOETE, S.W.P. & COETZEE, J., 1989. Invloed van langdurige behandeling van koringstrooi met ureum of 'n ureum/bytsodakombinasie tydens die baalproses op die voedingswaarde daarvan vir skape. *Suid-Afrikaanse Tydskrif vir Veekunde* 19, 19-26.
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- ESTERHUYSE, C.D., SCHOONRAAD, H.M.I. & NIEMAND, S.D., 1989. Samestelling van slukdermonsters en inname van skape op oesreste. Kongres van Suid-Afrikaanse Vereniging vir Diereproduksie, 28.
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• Upgrading/Veredeling

- CLOETE, S.W.P. & HAUGHEY, K.G., 1988. Preliminary note on mature pelvic dimensions and rearing efficiency in Merino ewes. *South African Journal of Animal Science* 18, 171-174.

• Pathology/Patologie

- HAUGHEY, K.G., 1989. Studies on causes of perinatal lamb mortality in the Western Cape and the pelvic dimensions of ewes relative to their lifetime rearing performance. *Research Report*, Department of Agriculture and Water Supply. Winter Rainfall Region, RSA. February 1989.
- VAN NIEKERK, F.E. & VAN NIEKERK, C.H., 1989. The influence of an experimentally induced copper deficiency on the fertility of rams. I. Semen parameters and peripheral plasma androgen concentration. *Journal of the South African Veterinary Association* 60, 28-31.
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- *Management/Bestuur*

- GROBBELAAR, P.D., 1988. Oorsig van sommige wolnavorsing op die Landboukollege Grootfontein. *Karoo Agric* 4(1), 13-16.
- GROBBELAAR, P.D., 1989. Wol moet bly. *Goue Vag* 18(11), 10-11.

- *Technology/Tegnologie*

- VAN DER WESTHUYSEN, J.M., WENTZEL, D. & GROBLER, M.C., 1988. *Angora goats and mohair in South Africa*. 3rd. ed. Jansenville, South African Mohair Grower's Association.

Non-ruminants/Nie-herkouers

OSTRICHES/VOLSTRUISE

- *Management/Bestuur*

- SWART, D., 1988. Studies on the hatching, growth and energy metabolism of ostrich chicks (*Struthio camelus* var. *domesticus*). Ph.D.(Agric.) dissertation, University of Stellenbosch.
- SWART, D., RAHN, H. & DE KOCK, J., 1987. Nest micro-climate and incubation water loss of eggs of the African ostrich (*Struthio camelus* var. *domesticus*). *Journal of Experimental Zoology* (Supplement 1), 239-246. (Also published in: Development of the avian embryo. 1987. Eds J. Metcalf, M.K. Stock & R.L. Ingerman, Alan R. Liss. New York, USA, pp. 239-246.)
- SWART, D. & RAHN, H., 1988. Micro-climate of ostrich eggs: measurements of egg temperature and nest humidity using egg hygrometers. *Journal of Comparative Physiology* 157, 845-853.

RESOURCE UTILISATION RESEARCH (PASTURE) HULPBRONBENUTTINGSNAVORSING (WEIDING)

Regional pasture/Streeksweiding

VELD

- *Physiology/Fisiologie*

- DANCKWERTS, J.E. & GORDON, A.J., 1988. The effect of leaf age on the photosynthetic rate of *Themeda triandra* Forsk. *Journal of the Grassland Society of Southern Africa* 5(4), 227-228.
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- *Ecology/Ekologie*

- DANCKWERTS, J.E., 1988. Units for expressing stocking rate and carrying (or grazing) capacity. *Ciskei Agricultural Journal* 1st Quarter, Volume 7, 13-15 (Review.)
- ROUX, P.W. & VORSTER, M., 1989. Vegetation change in the Karoo. *Karoo Veld Merino Club Autumn Journal* 14.

• *Crop science/Gewaskunde*

- COX, J.R., LYLE, G.B., FOURIE, J.H. & DONALDSON, C.H., 1988. Lehmann lovegrass - Central South Africa and Arizona, U.S.A. *Rangelands* 10(2), 53-55.
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- MOORE, A., VAN ECK, J.A.J., VAN NIEKERK, J.P. & ROBERTSON, B.L., 1988. Evapotranspirasie in die plantgemeenskappe van 'n *Rhigozum trichotomum* habitat te Upington. *Tydskrif van die Weidingsvereniging van Suid-Afrika* 5, 80-84.
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- TEAGUE, W.R., 1988. The response of *Acacia karroo* plants to defoliation by hand compared to defoliation by goats. *Journal of the Grassland Society of Southern Africa* 5(3), 122-124.
- TEAGUE, W.R. & WALKER, B.H., 1988. Effect of intensity of defoliation by goats at different phenophases on leaf and shoot growth of *Acacia karroo* Hayne. *Journal of the Grassland Society of Southern Africa* 5(4), 197-206.

• *Potential studies/Potensiaalstudies*

- BECKERLING, A.C., 1989. The present condition and potential of the veld in the Highveld Region. *Hoëveldfokus*, 1/89, 5-7.
- DANCKWERTZ, J.E. & DREWES, R.H., 1989. Veelading en drakrag. *Agriforum*.
- HOBSON, F.O. & BARNHOORN, A.S.J., 1988. Exploring the potential of the descending point method to measure utilisation in Karoo veld. *Journal of the Grassland Society of Southern Africa* 5, 102-107.
- MARAIS, P.G., HERSELMAN, M.J. & LINTVELT, H.G.J., 1988. Voedingswaarde van behandelde en onbehandelde suurpol (*Merxmuellera disticha*). *Karoo Agric* 4(1), 9-12.
- MARINCOWITZ, G., 1989. Soutpan se suksesformule - jongste navorsingsresultate. *Red-Meat* 32-34.
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- ROUX, P.W. & VAN DER VYVER, J., 1988. Agricultural potential of the Eastern Cape and Cape Midlands. In: Towards an enviromental plan for the Eastern Cape. M.N. Bruten & F.W. Gess. Grahamstown: RU,100-125.
- STUART-HILL, G.C. & TANTON, N.M., 1988. Browse and herbage production in the Eastern Cape Thornveld in response to tree size and defoliation frequency. *Journal of the Grassland Society of Southern Africa* 5(1), 42-47.
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• *Evaluation/Evaluasie*

- ROUX, F.A., 1988. Kwantitatiewe plantkundige vergelyking tussen 'n noord- en suidhelling in die Skyn Hoër Karoo. *Karoo Agric* 4(1), 17-26.

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PROJECTS/PROJEKTE

PLANT PRODUCTION PROMOTION PLANTPRODUKSIEBEVORDERING

AGRONOMY RESEARCH/AKKERBOUNAVORSING

Summer grain/Somergraan

MAIZE/MIELIES

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- GG.2111/30/3/22: Screening of maize cultivars suited for production in stubble situations. 1984. P.M. Lang
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- *Modelling/Modellering*

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GRAIN SORGHUM/GRAANSORGHUM

- *Physiology/Fisiologie*

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- *Upgrading/Veredelning*

- GG.2112/07/1/1: Breeding for general disease resistance in grain sorghum. 1986. N.W. McClaren
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- *Pathology/Patologie*

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- *Pests/Plae*

- GG.2112/20/1/1: Occurrence, distribution and ecology of ectoparasitic nematodes associated with sorghum in the sorghum producing areas. 1985. D.G.M.A. de Waele
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- GG.2112/30/2/1: Influence of row width, stand and planting dates on grain sorghum. 1987. A.J. Pretorius
- GG.2112/30/2/2: The compensation ability of grain sorghum yield. 1983. A.J. Pretorius
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- *Chemistry/Chemie*

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BUCKWHEAT/BOKWIET

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- GG.2113/30/1/1: Evaluation of buckwheat cultivars for agricultural industrial value and adaptability. 1974. A.J. Pretorius

Small grain/Kleingraan

WHEAT/KORING

• *Physiology/Fisiologie*

- GG.2121/03/1/1: Determination of the temperature requirement of wheat. 1982. G.D. Joubert
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- GG.2121/07/3/2: The influence of gamma rays on wheat gametophytes. 1976. H.A. van Niekerk
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- GG.2121/07/4/2: The upkeep of unique wheat germ plasm. 1981. M.T. Aartsma
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- GG.2121/07/5/6: The influence of nitrogen uptake and metabolism on grain quality of wheat lines. 1979. H.A. van Niekerk

• Pathology/ Patologie

- GG.2121/19/1/1: Occurrence and distribution of root-and-foot-rot disease in wheat. 1978. B. de Scott
- GG.2121/19/1/3: The influence of fertilisers and crop rotation on the occurrence of take-all (*Gaeumannomyces graminis* var. *tritici*) in irrigated wheat. 1983. E.M.C. Maas
- GG.2121/19/1/5: Chemical control of root disease in wheat. 1982. E.M. Smith
- GG.2121/19/1/9: Evaluation of wheat cultivars for resistance against take-all (*Gaeumannomyces graminis* var. *tritici*). 1988. G.H.J. Kemp
- GG.2121/19/2/1: Observations on the occurrence of air-borne diseases of wheat in South Africa. 1980. Z.A. Pretorius
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- GG.2121/20/1/4: Soil treatment with systemic insecticides for the chemical control of the Russian wheat aphid, *Diuraphis noxia*. 1980. F. du Toit
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- GG.2121/20/1/9: The evaluation of wheat breeding material for resistance to the oat aphid *Rhopalosiphum padi* and the ear aphid *Sitobion avenae*. 1985. F. du Toit
- GG.2121/20/2/1: The occurrence and distribution of injurious soil insects in wheat. 1983. F. du Toit
- GG.2121/20/2/2: Chemical control of false wire worm (Tenebrionidae) in wheat with soil and seed treatment. 1984. F. du Toit
- GG.2121/20/3/1: Survey of eelworm species in the wheat producing areas. 1983. H.A. van Niekerk
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- GG.2121/30/3/2: Determination of the optimum planting date and sowing rate of wheat cultivars in the summer rainfall area. 1983. J.L. Purchase
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- GG.2121/30/4/2: The influence of stubble mulching on grain yield of wheat in the summer rainfall area. 1982. H.A. Smit
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- GG.2121/30/6/1: The application of herbicides on different stages of wild oats in wheat in the winter rainfall area. 1982. H.A. Smit
- GG.2121/30/6/3: Phytotoxicity of wild oats and grass herbicides in promising wheat lines and new wheat cultivars in the Winter Rainfall Region. 1982. H.A. Smit
- GG.2121/30/6/4: Phytotoxicity of wild oats and grass herbicides on promising wheat lines and new wheat cultivars in the summer rainfall area. 1982. H.A. Smit
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- GG.2121/30/7/3: Phytotoxicity of broad-leaf herbicides on promising wheat lines and new wheat cultivars in the summer rainfall region. 1982. H.A. Smit
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- GG.2121/53/1/3: The identification of wheat cultivars by means of prolamine electrophoresis profiles. 1980. H.A. van Niekerk

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• *Upgrading/Veredelings*

- GG.2122/07/1/1: The evaluation of elite newly developed and introduced cultivars. 1976. C. Bothma
- GG.2122/07/2/1: The selection of meiotic stable breeding parents from advanced triticale lines. 1976. H.A. van Niekerk
- GG.2122/07/3/1: The evaluation of triticale germ plasm. 1981. I.B.J. Smit
- GG.2122/07/3/2: The upkeep of unique triticale germ plasm. 1981. M.T. Aartsma
- GG.2122/07/3/3: The development of a computerised database for unique triticale germ plasm. 1983. M.T. Aartsma

DURUM

• *Nutrition/Voeding*

- GG.2123/05/1/1: Effect of nitrogen fertilisation on the production and quality of durum wheat under irrigation. 1982. W.H. Killian

• *Upgrading/Veredeling*

- GG.2123/07/1/1: The evaluation of elite newly developed and imported durum lines. 1976. H.A. van Niekerk
- GG.2123/07/2/1: The evaluation of durum germ plasm. 1981. I.B.J. Smit
- GG.2123/07/2/2: The upkeep of unique durum germ plasm. 1981. M.T. Aartsma
- GG.2123/07/2/3: The development of a computerised database for durum production. 1983. M.T. Aartsma
- GG.2123/07/3/1: The quality evaluation of all newly developed durum lines. 1976. H.A. van Niekerk

BARLEY/GARS

• *Physiology/Fisiologie*

- GG.2124/03/1/1: Determination of factors which cause black-end coloration to barley in the winter rainfall area. 1982. E.J.G. Brand

• *Upgrading/Veredeling*

- GG.2124/07/1/1: The breeding of barley and evaluation of elite newly developed and imported cultivars. 1976. P.B. le Grange
- GG.2124/07/2/1: The evaluation of barley germ plasm. 1981. I.B.J. Smit
- GG.2124/07/2/2: The upkeep of unique barley germ plasm. 1981. M.T. Aartsma
- GG.2124/07/2/3: The development of a computerised database for barley germ plasm. 1983. M.T. Aartsma
- GG.2124/07/3/1: Quality evaluation of all new barley lines for brewing characteristics. 1976. L. van Lill

• *Pathology/Patologie*

- GG.2124/19/1/1: Observations on the occurrence of foliar diseases on barley in the Western Cape Province. 1988. D.B. Scott
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- GG.2124/30/1/1: Seed multiplication of elite barley lines and cultivars in the winter rainfall area. 1982. E.J.G. Brand
- GG.2124/30/1/2: Seed multiplication of the elite barley lines and cultivars in the summer rainfall area. 1982. G.D. Joubert
- GG.2124/30/2/1: Determination of the optimum planting date and sowing rate of barley cultivars in the winter rainfall area. 1983. E.J.G. Brand
- GG.2124/30/3/1: Leaf number/apex development stage relationship of barley in the winter rainfall area as influenced by chemical weedicides. 1982. H.A. Smit
- GG.2124/30/3/2: Phytotoxicity of wild oat herbicides on barley in the winter rainfall area. 1982. H.A. Smit
- GG.2124/30/3/3: Phytotoxicity of herbicides on promising barley lines and new barley cultivars in the summer rainfall area. 1982. H.A. Smit
- GG.2124/30/3/4: The determination of the apex development stages of barley for the safe application of hormone type herbicides in the summer rainfall area. 1982. H.A. Smit

RYE/ROG

• *Upgrading/Veredeling*

- GG.2125/07/1/1: The evaluation of elite newly bred and imported rye lines. 1976. H.A. van Niekerk
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OATS/HAWER

• *Upgrading/Veredeling*

- GG.2126/07/1/1: The evaluation of elite newly developed oat lines and introductions. 1976. M.T. Aartsma
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GROUNDNUTS/GRONDBONE

• *Physiology/Fisiologie*

- GG.2131/03/1/1: Groundnuts: partitioning analysis. 1981. J. Dreyer
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• *Nutrition/Voeding*

- GG.2131/05/1/1: NPK fertiliser studies with groundnuts. 1983. H.L. Loubser
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• *Upgrading/Veredeling*

- GG.2131/07/1/1: Evaluation of introductions and breeding parents of groundnuts. 1974. P.J.A. van der Merwe
- GG.2131/07/1/2: The improvement of groundnuts for dryland conditions. 1974. P.J.A. van der Merwe
- GG.2131/07/1/3: The improvement of groundnuts for irrigation areas. 1974. P.J.A. van der Merwe
- GG.2131/07/1/5: Studying and development of anther culture techniques in aid of development of new groundnut cultivars. 1986. P.C.W. van der Walt

• *Pathology/Patologie*

- GG.2131/19/1/1: Fusarium diseases of dryland cultivated groundnuts. 1985. S.H. Swart
- GG.2131/19/2/1: *Macrophomina* infections on groundnuts. 1985. E.L. Holtzhausen
- GG.2131/19/3/1: The influence of groundnut root and pod exudates on *Chalara elegans*. 1984. J.R. Anderson
- GG.2131/19/3/2: The influence of groundnut rhizosphere micro-organisms in controlling/stimulating *Chalara elegans* infestation. 1984. J.R. Anderson
- GG.2131/19/3/3: Interactions between *Chalara elegans* and saprophytic or ecto-parasitic nematodes in the dissemination of disease (black hull) on groundnuts. 1984. J.R. Anderson
- GG.2131/19/3/4: Method of entry of *Chalara elegans* into groundnut tissue. 1984. J.R. Anderson
- GG.2131/19/3/5: Development of reproducible and accurate method for enumerating spores of *Chalara elegans* in groundnuts, soils and plant debris. 1984. J.R. Anderson
- GG.2131/19/3/6: Laboratory studies on the nutritional requirements and biochemical pathways of *Chalara elegans* as found on groundnuts. 1984. J.R. Anderson
- GG.2131/19/3/7: Laboratory and greenhouse preliminary screens on groundnuts for biocides active against *Chalara elegans*. 1984. J.R. Anderson
- GG.2131/19/3/8: Developing of laboratory-greenhouse method for testing groundnut genotypes for resistance to *Chalara elegans*. 1983. B.L. Jones
- GG.2131/19/3/9: The use of crop rotations in controlling *Chalara elegans* in groundnuts. 1983. B.L. Jones
- GG.2131/19/3/10: Survey of naturally occurring *Chalara elegans* in the groundnut production areas of the RSA. 1982. B.L. Jones
- GG.2131/19/3/11: Biological control of *Chalara elegans* in groundnuts. 1982. J.R. Anderson
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• *Pests/Plae*

- GG.2131/20/1/1: *Hilda patruelis* and mould on groundnuts. 1984. C.J. Swanevelder
- GG.2131/20/2/1: A survey of the incidence of plant parasitic nematodes on groundnuts in South Africa. 1987. C. Bolton
- GG.2131/20/2/2: The occurrence of *Ditylenchus destructor* on groundnuts and its effect on groundnut production. 1987. C. Bolton
- GG.2131/20/2/3: Pathogenicity of *Ditylenchus destructor* to groundnut genotypes. 1988. C. Bolton
- GG.2131/20/2/7: Survival of *Ditylenchus destructor* on groundnuts. 1987. D.G.M.A. de Waele
- GG.2131/20/2/8: Chemical control of *Ditylenchus destructor* on groundnut fields. 1987. A.H. McDonald
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Crop science/Gewaskunde

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- GG.2131/30/2/2: Ridge planting of groundnuts for limiting black hull. 1982. J. Dreyer
- GG.2131/30/2/3: Harvesting techniques and mould contamination of groundnuts. 1985. C.J. Swanevelder
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- GG.2131/30/2/5: Basin tillage in groundnut production. 1984. E.B. Birch
- GG.2131/30/3/1: The influence of planting date on runner type groundnuts. 1985. C.J. Swanevelder
- GG.2131/30/4/1: Determining the effect of nut grass, *Cyperus* spp. on the yield of groundnuts. 1982. A.P.J. de Beer
- GG.2131/30/4/2: The effect of Dinitroanilien herbicide on the growth and development of the runner type groundnuts. 1983. A.P.J. de Beer
- GG.2131/30/5/1: The influence of mulching on mould contamination of groundnuts. 1984. C.J. Swanevelder
- GG.2131/30/8/1: Studies on spacing with newly released groundnut cultivars. 1985. C.J. Swanevelder

SUNFLOWERS/SONNEBLOMME

• *Nutrition/Voeding*

- GG.2132/05/1/4: The effect of mycorrhiza on the utilisation of phosphorus by sunflowers. 1985. H.L. Loubser
- GG.2132/05/1/5: The influence of nitrogen and moisture levels on the growth and yield of sunflowers. 1985. H.L. Loubser
- GG.2132/05/1/6: The effect of nitrogen, phosphorus and moisture levels on the nitrogen and phosphorus removal by different plant components. 1984. H.L. Loubser
- GG.2132/05/1/7: The effect of nitrogen and phosphorus levels on the growth and yield of sunflowers under irrigation. 1985. H.L. Loubser

• *Upgrading/Veredeling*

- GG.2132/07/1/1: Introduction and evaluation of sunflower lines for use in a breeding programme. 1974. W.J. Vermeulen
- GG.2132/07/1/2: The breeding of sunflower restorer lines and composites for utilisation in hybrid breeding. 1974. B.C. Greyling
- GG.2132/07/1/3: The breeding of sunflower A/B lines and composites for utilisation in hybrid breeding. 1974. W.J. Vermeulen

• *Pathology/Patologie*

- GG.2132/19/1/1: *Macrophomina* infections of sunflower. 1985. E.L. Holtzhausen
- GG.2132/19/2/1: Bacterial stalk rot of sunflower. 1985. L. van der Walt

• *Crop science/Gewaskunde*

- GG.2132/30/1/1: Evaluation of sunflower cultivars in different production areas. 1978. H.L. Loubser

- GG.2132/30/1/2: The ability of sunflower cultivars to compensate for low plant populations. 1983. H.L. Loubser
- GG.2132/30/1/5: Self-pollination and self-compatibility of sunflower cultivars. 1985. E.B. Birch
- GG.2132/30/1/6: Tolerance of sunflower cultivars to Al toxicity. 1983. E.B. Birch
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- GG.2132/30/2/7: Millet mulching in sunflower production. 1985. E.B. Birch
- GG.2132/30/2/8: Mulch crops in sunflower production. 1985. E.B. Birch

• *Modelling/Modellering*

- GG.2132/42/1/1: Predicting of the effect of nitrogen fertilisation and moisture supply on the yield of sunflowers. 1985. H.L. Loubser

SOYBEANS/SOJABONE

• *Physiology/Fisiologie*

- GG.2133/03/1/2: Interaction between yield components and interplant competition of soybeans. 1985. M.A. Smit
- GG.2133/03/1/3: Identification of soybeans on a biochemical level. 1987. C. Sullivan

• *Nutrition/Voeding*

- GG.2133/05/1/1: The interaction of lime on nitrogen, phosphorus and potassium fertilisation on soybeans. 1983. J. Chapman

• *Upgrading/Veredeling*

- GG.2133/07/1/1: Evaluation of soybean lines/introductions for use as commercial cultivars and/or as parents in a breeding programme. 1983. T.E.M. Odendaal
- GG.2133/07/1/2: The selection and generation of segregating material. 1984. T.E.M. Odendaal

• *Integrated control/Geïntegreerde beheer*

- GG.2133/23/1/1: The specific susceptibility of different soybean cultivars to herbicides. 1987. T.H. Bantjes

• *Crop science/Gewaskunde*

- GG.2133/30/1/1: Evaluation of soybean cultivars in different production areas. 1978. J.N.H. Lemmer
- GG.2133/30/1/2: The influence of plant population and row spacing on different soybean cultivars. 1984. J.N.H. Lemmer
- GG.2133/30/1/3: Tolerance of soybean, sunflower and dry bean cultivars to Al toxicity. 1982. M.A. Smit
- GG.2133/30/1/4: Genotype x environment interactions on yield tests and the application to a soybean breeding programme. 1984. T.E.M. Odendaal
- GG.2133/30/2/1: Basin tillage in soybean production. 1984. E.B. Birch

DRY BEANS/DROëBONE

• Nutrition/Voeding

- GG.2134/05/1/1: The effect of nitrogen application levels at different growth stages of dry beans. 1983. A.J. Liebenberg

• Upgrading/Veredeling

- GG.2134/07/1/1: The evaluation of dry bean introductions. 1970. W.J. Vermeulen
GG.2134/07/1/2: The breeding of dry beans for canning purposes. 1970. W.J. Vermeulen
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• Pathology/Patologie

- GG.2134/19/1/1: The production of disease-free dry bean (*Phaseolus vulgaris*) seed at Lutzville and Burgershall. 1977. A.J. Liebenberg
GG.2134/19/1/2: The production of disease-free dry bean (*Phaseolus coccineus*) seed. 1984. A.J. Liebenberg
GG.2134/19/2/1: Survey of fungal diseases on dry bean roots in the summer rainfall regions of South Africa. 1985. S.H. Swart
GG.2134/19/2/2: Survey of fungal diseases on the pods of dry beans in the summer rainfall regions of South Africa. 1985. S.H. Swart
GG.2134/19/2/3: Survey of fungal diseases on dry bean leaves in the summer rainfall regions of South Africa. 1985. S.H. Swart
GG.2134/19/3/1: Macrophomina infections of dry beans. 1985. E.L. Holtzhausen
GG.2134/19/4/1: Halo blight of dry beans. 1985. L. van der Walt
GG.2134/19/4/2: Common blight (*Xanthomonas phaseoli*) of dry beans. 1985. L. van der Walt

• Crop science/Gewaskunde

- GG.2134/30/1/1: The evaluation of dry bean cultivars in different production areas. 1983. A.J. Liebenberg
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GG.2134/30/1/3: The evaluation of dry bean cultivars and breeding lines for drought resistance. 1983. A.J. Liebenberg
GG.2134/30/1/4: The evaluation of the International Bean Yield and Adaptation Nursery (IBYAN) of CIAT. 1983. A.J. Liebenberg
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GG.2134/30/1/8: Effect of herbicides on the growth and development of different dry bean (*Phaseolus vulgaris*) cultivars. 1983. A.P.J. de Beer
GG.2134/30/1/9: Tolerance of soybean, sunflower and dry bean cultivars to Al toxicity. 1982. A.J. Liebenberg
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LUPINS/LUPIENE

• Physiology/Fisiologie

- GG.2135/03/1/1: A study on the effect of daylength and temperature on the growth and development of *Lupinus albus*, *Lupinus mutabilis* and other lupin species. 1985. J.A.M. van der Mey
- GG.2135/03/2/1: A survey on the occurrence of different alkaloids in lupin species and lines for the summer rainfall areas. 1985. J.A.M. van der Mey
- GG.2135/03/2/2: Testing for seed coat hardness in lupin species and lines for the summer rainfall areas. 1985. J.A.M. van der Mey

• Nutrition/Voeding

- GG.2135/05/1/1: The influence of fertiliser placement on germination, growth, development and seed yield of lupins. 1985. H.L. Loubser
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- GG.2135/05/1/3: Plant nutritional studies on lupins with macro-elements in the summer rainfall areas. 1985. H.L. Loubser
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- GG.2135/07/1/3: Genetics and breeding of lupins. 1981. J.A.M. van der Mey

• Pathology/Patologie

- GG.2135/19/1/1: Survey of root diseases on lupins in the summer rainfall region of South Africa. 1985. D.E. Malan
- GG.2135/19/1/2: Survey of leaf and pod diseases on lupins in the summer rainfall area. 1985. D.E. Malan
- GG.2135/19/1/3: Survey of stem diseases of lupins in the summer rainfall area of South Africa. 1985. D.E. Malan
- GG.2135/19/2/1: Macrophomina infection of lupins. 1985. E.L. Holtzhausen

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- GG.2135/30/3/2: Control of broad-leaf weeds in lupin plantings in the summer rainfall areas. 1985. A.P.J. de Beer
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OTHER SEEDS/ANDER SADE

• Crop science/Gewaskunde

- GG.2136/30/1/1: Other seeds: introduction of cowpea breeding material. 1985. J.J. Coetzee
- GG.2136/30/2/1: Other seeds: evaluation of bambara in different production areas. 1984. C.J. Swanevelder

Other agronomic crops/Ander akkerbougewasse

COTTON/KATOEN

• Physiology/Fisiologie

- TK.2141/03/1/3: The effect of moisture stresses and lower night temperatures on CO₂ absorption of short-season cotton cultivars. 1988. D. Meyer
- TK.2141/03/1/4: The effect of moisture stresses at different growth stages on CO₂ assimilation, growth and yield of different cotton cultivars. 1988. D. Meyer

• Nutrition/Voeding

- TK.2141/05/1/1: Response of cotton to nitrogen application with petiole analyses as diagnostic aid. 1980. M.C. Dippenaar
- TK.2141/05/1/2: Long-term NPK fertiliser study with cotton. 1972. M.C. Dippenaar
- TK.2141/05/1/3: Influence of mutual relation among nutrient elements in the soil and in cotton plants on the yield potential. 1983. N.J.J. Combrink
- TK.2141/05/2/1: Quantitative determination of nitrogen on the auto analyser. 1987. C.J. Steenkamp

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- TK.2141/07/1/1: Cotton breeding and selection. 1974. A.I. Greeff
- TK.2141/07/1/2: Introduction of cotton breeding lines and cultivars from abroad. 1974. A.P.F. Cornelissen
- TK.2141/07/1/4: Evaluation of the earliness of cotton (*Gossypium hirsutum*) as a factor in better insect pest and agronomic management. 1985. H.G. van Heerden
- TK.2141/07/2/1: Evaluation of cotton breeding lines. 1960. A.I. Greeff
- TK.2141/07/2/2: National cotton cultivar trials. 1975. G.S.P. Vink
- TK.2141/07/2/3: Recovery of cotton breeding lines after a period of moisture or temperature stress. 1983. H.G. van Heerden

• Pathology/Patologie

- TK.2141/19/1/1: Occurrence of different races of *Xanthomonas malvacearum* on cotton in South Africa. 1983. A. Swanepoel
- TK.2141/19/1/2: Pathogens associated with cotton seed and seedling diseases and its control. 1985. A. le Roux

• Pests/Plae

- TK.2141/20/1/2: Survey and identification of parasitic nematodes in different cotton producing areas. 1982. R.J. van Wyk

- TK.2141/20/1/3: The effect of nematocides on different nematode species and populations on cotton. 1985. E.R. van Biljon
- TK.2141/20/1/4: The refinement of infra-red detection techniques (for remote sensing) to determine nematode infestation in cotton for improved management. 1985. M.S. Greeff
- TK.2141/20/1/5: Survey of parasitic nematodes which occur in association with cotton including rotation crops and weeds. 1986. M.S. Greeff
- TK.2141/20/1/6: Development of mass rearing techniques of *Paratrichodorus* spp. (stubby root nematode), including *in vitro* mass rearing in cotton. 1988. E.R. van Biljon
- TK.2141/20/2/1: Evaluation of boll worm and flea beetle damage as influenced by different morphological/physiological attributes of cotton. 1987. E.G. Eulitz
- TK.2141/20/2/2: Determination of damage by flea beetle *Nisotra weisei* (Jacoby) on cotton. 1987. E.G. Eulitz
- TK.2141/20/2/3: Pest status of boll worm and flea beetle on ratoon cotton. 1987. E.G. Eulitz
- TK.2141/20/2/5: Evaluation of chemical products for the control of the boll worm complex in cotton. 1988. R. van der Westhuizen
- TK.2141/20/3/1: The evaluation of cotton cultivars resistance to red spider mite. 1988. A. Nel

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- TK.2141/30/1/2: Mulching and cultivation practices for cotton. 1983. G.S.P. Vink
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- TK.2141/30/1/4: Determination of the adaptability of short-season cotton cultivars with reference to plant density and row spacing. 1988. T.J. Meyer
- TK.2141/30/1/5: Determination of drought resistance and the mechanisms involved between cultivars with production practices on cotton. 1988. D. Meyer
- TK.2141/30/2/1: Chemical defoliation of cotton. 1982. J.N. de Kock

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- TK.2141/31/1/2: Effect of moisture deficits on different cotton cultivars and breeding lines. 1982. M.C. Dippenaar
- TK.2141/31/1/4: The effect of irrigation and dripper spacing on the growth and yield of cotton. 1988. C. Barnard
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- TK.2141/31/1/6: The effect of irrigation systems, irrigation management and plant population on growth and yield of cotton. 1988. C. Barnard

TOBACCO/TABAK

• *Physiology/Fisiologie*

- TK.2142/03/1/1: Measuring of physical characteristics of flue-cured tobacco leaf. 1987. N.J.J. Combrink
- TK.2142/03/1/2: Measurement of leaf ripeness before harvest. 1987. N.J.J. Combrink
- TK.2142/03/1/4: The effect of moisture stress on CO₂ assimilation, plant development and leaf quality of flue-cured tobacco. 1988. D. Meyer

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- TK.2142/05/1/1: Nitrogen indices for and nitrogen supply of the Arcadia soil series for tobacco. 1972. C.J. Steenkamp
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- TK.2142/05/1/9: Micro-nutrients of tobacco. A survey of the present situation in the tobacco producing areas and to obtain analytical norms. 1987. C.J. Steenkamp
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• *Upgrading/Veredeling*

- TK.2142/07/1/1: Determination of breeding value of flue-cured tobacco. 1964. H.G. van Heerden
- TK.2142/07/1/2: Determination of breeding value of dark air-cured tobacco. 1964. V. le Grange
- TK.2142/07/1/3: Determination of breeding value of light air-cured tobacco. 1967. V. le Grange
- TK.2142/07/1/4: Determination of breeding value of burley tobacco. 1969. H.G. van Heerden
- TK.2142/07/1/5: Determination of breeding value of Oriental tobacco. 1969. H.G. van Heerden
- TK.2142/07/1/7: Inbreeding of the male sterility factor in some *Nicotiana tabacum* cultivars. 1956. A.P.F. Cornelissen
- TK.2142/07/1/8: Breeding of *Nicotiana tabacum* cultivars resistant to diseases. 1952. H.G. van Heerden
- TK.2142/07/1/12: A germ plasm collection of tobacco (*Nicotiana*). 1985. A.P.F. Cornelissen
- TK.2142/07/1/13: The role played by *in vivo* and *in vitro* translation systems for the characterisation and screening of potato virus Y strains in different tobacco cultivars. 1986. M.J. Bosch
- TK.2142/07/1/14: The transfer of disease resistance from *Nicotiana repanda* to *Nicotiana tabacum* cultivars. 1986. M.J. Bosch
- TK.2142/07/1/15: Improvement of air-cured tobacco varieties via the anther culture technique. 1986. M.J. Bosch
- TK.2142/07/1/16: Production and evaluation of F₁ hybrids and male sterility types of potential tobacco breeding materials. 1987. A.P.F. Cornelissen
- TK.2142/07/1/17: The inheritance-pattern of the resistance to root-knot nematodes in certain (KNST) tobacco breeding lines. 1985. A.P.F. Cornelissen
- TK.2142/07/1/18: Breeding of commercial flue-cured tobacco varieties with resistance to root-knot nematode. 1985. A.P.F. Cornelissen
- TK.2142/07/1/19: Production of air-cured tobacco varieties with root-knot nematode resistance. 1986. A.P.F. Cornelissen
- TK.2142/07/1/20: Production of burley tobacco varieties with root-knot nematode resistance. 1986. A.P.F. Cornelissen
- TK.2142/07/1/21: Production of Oriental tobacco varieties with root-knot nematode resistance. 1986. A.P.F. Cornelissen
- TK.2142/07/2/1: Evaluation of flue-cured tobacco breeding lines. 1966. H.G. van Heerden
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- TK.2142/07/2/4: Evaluation of burley tobacco breeding lines. 1966. H.G. van Heerden
- TK.2142/07/2/5: Evaluation of Oriental tobacco breeding lines. 1958. H.G. van Heerden
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- TK.2142/19/2/4: Investigation of vectors and vection of Potato-Y virus of tobacco in the Lowveld: survey and identification of aphids and other insects. 1985. N.C.L. du Toit
- TK.2142/19/2/5: Evaluation of *Nicotiana* species, *N. tabacum* cultivar breeding lines for possible resistance against "bushy top". 1986. R.J. van Wyk
- TK.2142/19/2/6: Evaluation of *Nicotiana* species and *N. tabacum* cultivars for resistance against tomato spotted wilt virus. 1987. D.J. de Bruin
- TK.2142/19/2/7: A survey of the occurrence and distribution of economic important tobacco viruses in the tobacco production areas of the RSA. 1987. A. Swanepoel
- TK.2142/19/2/8: Evaluation of *Nicotiana* species, *N. tabacum* cultivars for resistance against the four races PVY. 1987. R.J. van Wyk
- TK.2142/19/2/9: The stability of the "bushy top" virus complex in tobacco. 1988. D.J. de Bruin
- TK.2142/19/2/10: The influence of alternative host plants on the occurrence and distribution of TMV, CMV, PVY and TEV. 1987. A. Swanepoel
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- TK.2142/19/3/1: The distribution of race and biotype of *Pseudomonas solanacearum* on tobacco. 1985. M.C. Engelbrecht
- TK.2142/19/3/2: Screening for resistance among *Nicotiana* spp. cultivars and breeding lines against *Pseudomonas solanacearum*. 1985. M.C. Engelbrecht
- TK.2142/19/3/3: Chemical control of bacterial wilt in tobacco. 1986. M.C. Engelbrecht
- TK.2142/19/3/5: An investigation to find an effective dosage of chlorpicrin mixture for the control of the bacterial wilt organisms in tobacco soils. 1988. D.A. de Villiers
- TK.2142/19/3/6: Cultivar reaction of local tobacco cultivars to chlorpicrin concentrations in tobacco soils will be determined. 1988. D.A. de Villiers

• Pests/ Plae

- TK.2142/20/1/5: Influence of soil characteristics on the decomposition of carbofuran in tobacco cultivation. 1985. E.G. Eulitz
- TK.2142/20/1/6: The time, leaf position and impact of boll worm attacks on tobacco. 1987. E.G. Eulitz
- TK.2142/20/2/5: The effect of nematocides on different nematode species and populations on tobacco. 1985. E.R. van Biljon
- TK.2142/20/2/6: Susceptibility of rotation crops with tobacco and weed in tobacco lands for species and races of *Meloidogyne*. 1986. J.C. Meyer

- TK.2142/20/2/7: The refinement of infra-red detection techniques (for remote sensing) to determine nematode infestation in tobacco for improved farm management. 1985. M.S. Greeff
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- TK.2142/20/3/2: Investigation to alternative host plants for the tobacco spidermite. 1987. C.L.N du Toit

• *Chemical control/Chemiese beheer*

- TK.2142/21/1/1: Chemical weed control in flue-cured tobacco plantings. 1968. C.R. Nolte
- TK.2142/21/1/2: Chemical weed control in Oriental tobacco plantings. 1980. C.R. Nolte

• *Crop science/Gewaskunde*

- TK.2142/30/1/1: Spacing and topping of flue-cured tobacco. 1966. F.J. Shawe
- TK.2142/30/1/6: Chemical control of suckers on tobacco. 1968. C.R. Nolte

• *Water requirements/Waterbehoefies*

- TK.2142/31/1/3: The effect of irrigation and dripper spacing on growth and yield on flue-cured tobacco. 1988. C. Barnard
- TK.2142/31/1/4: The effect of irrigation on growth and development of flue-cured tobacco. 1988. C. Barnard
- TK.2142/31/1/5: The effect of irrigation systems, irrigation management and plant population on growth yield, yield and leaf quality of tobacco. 1988. C. Barnard

SUNDRY AGRONOMIC CROPS/DIVERSE AKKERBOUGEWASSE

• *Crop science/Gewaskunde*

- GG.2143/30/1/1: Introduction of rice breeding material. 1980. J.J. Coetzee
- GG.2143/30/1/2: Evaluation of cultivars for agricultural value and adaptability. 1980. J.J. Coetzee

CHICORY/SIGOREI

• *Nutrition/Voeding*

- D.2144/05/1/1: The fertilisation of chicory on an Oakleaf-Limpopo. 1981. R.S. Marr

• *Upgrading/Veredeling*

- D.2144/07/1/1: The selection of chicory. 1975. R.S. Marr

• *Pathology/Patologie*

- TK.2144/19/1/1: Determination of the causal organism(s) of blackrot in chicory. 1985. G.C. Prinsloo

• *Pests/Plae*

- TK.2144/20/1/1: Preliminary survey of parasitic nematode genera in chicory. 1985. R.J. van Wyk
- TK.2144/20/1/2: Chemical control of parasitic nematodes in chicory. 1985. R.J. van Wyk

• *Crop science/Gewaskunde*

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DEPARTMENTAL GENE BANKS/DEPARTEMENTELE GENEBAKKE

Horticulture research/Tuinbounavorsing

GRAPEVINES/WINGERD

• *Upgrading/Veredeling*

- WW.2327/07/1/1: Maintenance and expansion of a grape gene bank. 1988. F.S. de Villiers

HORTICULTURE RESEARCH/TUINBOUNAVORSING

Tuber crops/Knolgewasse

POTATOES/AARTAPPELS

• *Physiology/Fisiologie*

- GS.2411/03/1/1: The influence of calcium on the cell wall and cell structure of potato tubers. 1983. Marianne W. Venter
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• *Nutrition/Voeding*

- GS.2411/05/1/1: Fertiliser requirements of potatoes at Lydenburg. 1980. K.P. Prinsloo
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• *Upgrading/Veredeling*

- GS.2411/07/1/1: Breeding of improved potato cultivars. 1983. A.F. Visser
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- GS.2411/07/2/4: Breeding and selection of potato cultivars for tolerance to virus diseases. 1963. A.F. Visser
- GS.2411/07/3/1: Genetic studies to broaden the genetic base of potato cultivars. 1975. A.F. Visser
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- GS.2411/19/1/2: Study and control of common scab on potatoes. 1978. B.W. Young
- GS.2411/19/1/4: Ecology and control of black scurf on potatoes. 1979. B.W. Young
- GS.2411/19/1/5: Control of silver scurf on potatoes. 1985. L. Marais
- GS.2411/19/1/6: Study of silver scurf on potatoes. 1985. L. Marais
- GS.2411/19/1/8: Study of anthracnose on potatoes. 1985. L. Marais
- GS.2411/19/1/9: Study of *Fusarium* spp. concerned with dry rot and stemrot of potatoes. 1985. D.J. Theron
- GS.2411/19/2/1: Bacterial wilt disease on potatoes caused by *Pseudomonas solanacearum*: isolation of causal bacteria. 1984. A.E. Swanepoel
- GS.2411/19/2/2: Bacterial wilt disease of potatoes caused by *Pseudomonas solanacearum*: symptom development. 1984. A.E. Swanepoel
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- GS.2411/19/3/4: Effect of tuber stimulation on the detection of potato viruses in tomatoes. 1987. P.J. Prins
- GS.2411/19/3/7: Potato virus Y in potatoes: identification and characterisation of strains. 1983. G.J. Thompson
- GS.2411/19/3/9: Elimination of non-specific reactions in the detection of potato viruses in potatoes. 1984. C. Coby

● *Pests/ Plae*

- GS.2411/20/1/1: Biological studies of black maize beetle in potatoes. 1984. J.M.I. Donaldson
- GS.2411/20/1/2: Bio-ecological studies of the potato snout beetle. 1984. J.M.I. Donaldson

● *Crop science/ Gewaskunde*

- GS.2411/30/1/1: Phase-2 evaluation of adaptibility of promising potato breeding lines in different areas. 1963. J.L. Schoeman
- GS.2411/30/1/2: Phase-2 evaluation of advanced breeding lines and imported cultivars in different areas. 1979. J.L. Schoeman
- GS.2411/30/1/3: Introduction and preliminary evaluation of foreign potato cultivars. 1973. A.F. Visser
- GS.2411/30/1/4: Evaluation of commercial acceptability of promising potato breeding lines and imported cultivars. 1987. D.C.A. Hoffman
- GS.2411/30/2/12: Optimal plant population for potatoes under irrigation. 1986. J.J. Nel
- GS.2411/30/3/1: Maintenance and multiplication of genetic resources of potatoes. 1987. D.C.A. Hoffman

Vegetables/Groente

TOMATOES/TAMATIES

- *Physiology/Fisiologie*

- GS.2421/03/1/1: Anther culture of tomatoes. 1987. J.A. Brink
GS.2421/03/1/2: Establishment and embryogenesis of cell cultures of tomatoes. 1987. R.P. de Villiers

- *Upgrading/Veredeling*

- GS.2421/07/1/1: Breeding and selection of market tomatoes. 1975. S.E. Bosch
GS.2421/07/1/2: Breeding and selection of processing tomatoes. 1975. S.E. Bosch

- *Pathology/Patologie*

- GS.2421/19/2/1: Evaluation of tomatoes for resistance to bacterial canker. 1975. B.H. Boelema
GS.2421/19/2/2: Phenotypic characteristics of *Pseudomonas syringae* pv. tomato, the bacterial speck pathogen of tomato. 1987. J.J. Serfontein
GS.2421/19/3/1: Identification and characterisation of the potyvirus group in tomatoes. 1981. G.J. Thompson
GS.2421/19/3/2: Identification and characterisation of tomato spotted wilt virus strains. 1981. G.J. Thompson

- *Pests/Plae*

- GS.2421/20/1/1: A study of plant parasitic eelworm on tomatoes. 1981. K.C. Daiber
GS.2421/20/1/2: Bio-ecological studies of *Liriomyza trifolii* on tomatoes. 1985. M.C. Bolton

- *Crop science/Gewaskunde*

- GS.2421/30/1/1: Evaluation of new market tomato cultivars and breeding lines. 1975. H.A. Dafel
GS.2421/30/1/2: Evaluation of processing tomato cultivars and breeding lines. 1975. H.A. Dafel
GS.2421/30/3/1: Maintenance and multiplication of genetic resources of tomatoes. 1987. D.C.A. Hoffman
GS.2421/30/3/2: Collection and description of genetic resources of tomatoes. 1987. C. Bester

- *Water requirements/Waterbehoefes*

- GS.2421/31/1/1: Measurement of tomato leaf water potential. 1985. H.A. Dafel

ONIONS/UIE

- *Upgrading/Veredeling*

- GS.2422/07/2/1: The breeding of F₁-hybrid onions. 1983. Elsa van der Klashorst

- *Pathology/Patologie*

- GS.2422/19/1/1: Study of *Pyrenochaeta terrestris*, the pink root pathogen of onions. 1983. J.F. Ferreira

GS.2422/19/1/2: Post-harvest decay of onions by *Aspergillus niger*: epidemiology and occurrence. 1987. S.P. Naudé

• *Crop science/Gewaskunde*

GS.2422/30/1/1: Evaluation of onion cultivars and breeding lines. 1977. A.G. Comrie

GS.2422/30/2/2: Planting density of onions. 1986. A.G. Comrie

GS.2422/30/3/1: Maintenance and multiplication of genetic resources of onions. 1987. P.O. Stork

GS.2422/30/3/2: Collection and description of genetic resources of onions. 1986. Elsa van der Klashorst

COLE CROPS/KOOLGEWASSE

• *Physiology/Fisiologie*

GS.2423/03/1/1: The influence of seed treatments on the germination/physiology of cole crops: cabbage. 1984. B.H. Boelema

• *Upgrading/Veredeling*

GS.2423/07/1/2: Cole crops: breeding and selection of cauliflower. 1976. A.A. van den Berg

• *Crop science/Gewaskunde*

GS.2423/30/1/1: Cole crops: phase-II evaluation of cabbage cultivars and breeding lines. 1976. P.J. Henrico

GS.2423/30/1/2: Cole crops: phase-II evaluation of cauliflower cultivars and breeding lines. 1975. C.P.J. Coetzee

GS.2423/30/1/3: Cole crops: phase-II evaluation of broccoli cultivars and breeding lines. 1981. W.P. Stapelberg

GS.2423/30/2/1: Maintenance and multiplication of genetic resources of cole crops. 1987. D.C.A. Hoffman

GS.2423/30/2/2: Collection and description of genetic resources of cole crops: cabbage. 1987. P.J. Henrico

GS.2423/30/2/3: Collection and description of genetic resources of cole crops: cauliflower. 1987. C.P.J. Coetzee

GS.2423/30/2/4: Collection and description of genetic resources of cole crops: broccoli. 1987. A.A. van den Berg

• *Water requirements/Waterbehoefies*

GS.2423/31/1/1: Determination of the water requirements of cole crops: cabbage. 1982. P.F. Nortje

ROOT CROP VEGETABLES/WORTELAGTIGE GROENTE

• *Anatomy/Anatomie*

GS.2424/02/1/1: Root crop vegetables: anatomical studies of root development in sweet potatoes. 1986. C.P. du Plooy

- *Physiology/ Fisiologie*

GS.2424/03/1/1: Root crop vegetables: physiology of storage root initiation and growth in sweet potatoes. 1986. C.P. du Plooy

- *Upgrading/ Veredeling*

GS.2424/07/1/1: Root crop vegetables: breeding and selection of sweet potatoes. 1976. C. Bester

GS.2424/07/1/2: Root crop vegetables: breeding and selection of industrial sweet potatoes. 1975. C. Bester

- *Pathology/ Patologie*

GS.2424/19/1/1: Root crop vegetables: virus diseases of root crop vegetables: sweet potatoes. 1981. G.J. Thompson

- *Crop science/ Gewaskunde*

GS.2424/30/1/1: Root crop vegetables: phase-II evaluation of sweet potato cultivars and breeding lines. 1975. A.A. van den Berg

GS.2424/30/2/1: Root crop vegetables: phase-II evaluation of new carrot cultivars and breeding lines. 1981. A.A. van den Berg

GS.2424/30/4/1: Maintenance and multiplication of genetic resources of root crop vegetables: sweet potatoes. 1987. P.O. Stork

GS.2424/30/4/2: Collection and description of genetic resources of root crop vegetables: sweet potatoes. 1987. C. Bester

GS.2424/30/4/3: Maintenance and multiplication of genetic resources of root crop vegetables: carrots. 1987. P.O. Stork

GS.2424/30/4/5: Maintenance and multiplication of genetic resources of root crop vegetables: beetroot. 1987. D.C.A. Hoffman

GS.2424/30/4/6: Collection and description of genetic resources of root crop vegetables: beetroot. 1987. Elsa van der Klashorst

- *Water requirements/ Waterbehoefies*

GS.2424/31/1/1: Water requirements of root crop vegetables: carrots. 1982. P.F. Nortje

LEGUME VEGETABLES/ PEULGROENTE

- *Upgrading/ Veredeling*

GS.2425/07/2/1: Legume vegetables: breeding and selection of green peas. 1975. S.E. Bosch

GS.2425/07/2/2: Legume vegetables: breeding and selection of dry peas. 1977. S.E. Bosch

- *Pathology/ Patologie*

GS.2425/19/1/1: Legume vegetables: a study of halo blight of green beans. 1975. B.H. Boelema

- *Crop science/ Gewaskunde*

GS.2425/30/1/1: Legume vegetables: phase-II evaluation of green bean cultivars and breeding lines. 1975. A.A. van den Berg

- GS.2425/30/2/2: Legume vegetables: phase-II evaluation of dry pea cultivars and breeding lines. 1977. C. Bester
- GS.2425/30/4/1: Maintenance and multiplication of genetic resources of legume vegetables: green beans. 1987. P.O. Stork
- GS.2425/30/4/2: Collection and description of genetic resources of legume vegetables: green beans. 1987. A.A. van den Berg
- GS.2425/30/4/3: Maintenance and multiplication of genetic resources of legume vegetables: peas. 1987. P.O. Stork
- GS.2425/30/4/4: Collection and description of genetic resources of legume vegetables: peas. 1987. C.E. Rappard
- GS.2425/30/5/1: An evaluation of the efficiency and phytotoxicity of herbicides on green beans. 1981. H.A. Dafel

VINE CROPS/RANKGEWASSE

• Upgrading/Veredeling

- GS.2426/07/1/1: Vine crop vegetables: breeding and selection of pumpkins. 1976. S.E. Bosch
- GS.2426/07/1/2: Vine crop vegetables: breeding and selection of muskmelon. 1976. J.J.B. van Zijl

• Crop science/Gewaskunde

- GS.2426/30/1/1: Vine crop vegetables: evaluation of pumpkin cultivars and breeding lines. 1977. C. Bester
- GS.2426/30/1/2: Vine crops: phase-II evaluation of muskmelon cultivars and breeding lines. 1976. Elsa van der Klashorst
- GS.2426/30/2/1: Weed control studies in pumpkin and squashes. 1982. H.A. Dafel
- GS.2426/30/3/1: Maintenance and multiplication of genetic resources of vine crops. 1987. D.C.A. Hoffman
- GS.2426/30/3/2: Collection and description of genetic resources of vine crops: pumpkins. 1987. Elsa van der Klashorst
- GS.2426/30/3/3: Collection and description of genetic resources of vine crops: muskmelon. 1987. A.G. Comrie
- GS.2426/30/3/4: Collection and description of genetic resources of vine crops: watermelons. 1987. C. Bester

SUNDRY VEGETABLES/DIVERSE GROENTE

• Physiology/Fisiologie

- GS.2427/03/1/1: Sundry vegetables: the rapid propagation of asparagus (*Asparagus officinalis*) by means of tissue culture. 1986. Martha M. Slabbert

• Crop science/Gewaskunde

- GS.2427/30/2/1: Sundry vegetables: cultivation studies with lettuce. 1983. C.P. du Plooy
- GS.2427/30/3/1: Maintenance and multiplication of genetic resources of sundry vegetables: garlic. 1987. D.C.A. Hoffman
- GS.2427/30/3/2: Collection and description of genetic resources of sundry vegetables: garlic. 1987. P.J. Henrico

Flowers and ornamental plants/Blomme en sierplante

PROTEAS

• *Physiology/Fisiologie*

- GS.2431/03/2/1: Rapid multiplication of proteas *in vitro*: *Leucospermum*. 1986. B.A. Rugge
GS.2431/03/2/2: Rapid multiplication of proteas *in vitro*: *Serruria florida*. 1986. B.A. Rugge
GS.2431/03/2/3: Rapid multiplication of proteas *in vitro*: *Protea*. 1987. D.I. Ferreira

• *Upgrading/Veredeling*

- GS.2431/07/1/2: Hybridisation studies with proteas: genus *Protea*. 1985. G.J. Brits
GS.2431/07/1/3: Mass selection for the upgrading of certain protea variants: genus *Protea*. 1985. G.J. Brits
GS.2431/07/1/4: Single plant selection for the development of new clonal cultivars of proteas. 1985. G.J. Brits
GS.2431/07/1/5: Upgrading of proteas as pot plants: genus *Protea*. 1987. G.J. Brits
GS.2431/07/2/1: Hybridisation studies with proteas: genus *Leucospermum*. 1985. G.J. Brits
GS.2431/07/2/2: Upgrading of proteas as pot plants: genus *Leucospermum*. 1987. G.J. Brits
GS.2431/07/3/1: Hybridisation studies with proteas: genus *Leucadendron*. 1986. B.A. Rugge
GS.2431/07/3/2: Upgrading of proteas as pot plants: genus *Leucadendron*. 1987. G.J. Brits
GS.2431/07/4/1: Upgrading of proteas as pot plants: genus *Serruria*. 1987. G.J. Brits

• *Pests/Plae*

- GS.2431/20/1/2: Bio-ecological studies of insects on proteas. 1986. J.H. Coetzee
GS.2431/20/2/1: Taxonomic studies of insects on proteas. 1986. J.H. Coetzee
GS.2431/20/2/2: Taxonomic studies of mites on proteas. 1986. J.H. Coetzee
GS.2431/20/3/1: Chemical control measures of pests on proteas. 1986. J.H. Coetzee

• *Crop science/Gewaskunde*

- GS.2431/30/1/2: Evaluation of protea cultivars and selections. 1978. G.J. Brits
GS.2431/30/2/3: Reproduction of proteas by means of grafting and budding. 1987. D.G. Malan
GS.2431/30/3/2: Cultivation of proteas in inert media. 1987. D.G. Malan
GS.2431/30/4/1: Maintenance and multiplication of genetic resources of proteas. 1987. G.C. van den Berg
GS.2431/30/4/2: Collection and description of genetic resources of proteas: genus *Protea*. 1986. G.C. van den Berg
GS.2431/30/4/3: Collection and description of genetic resources of proteas: genus *Leucospermum*. 1986. G.C. van den Berg
GS.2431/30/4/4: Collection and description of genetic resources of proteas: genus *Leucadendron*. 1986. G.C. van den Berg
GS.2431/30/4/5: Collection and description of genetic resources of proteas: genus *Serruria*. 1986. G.C. van den Berg

- GS.2431/30/4/6: Collection and description of genetic resources of proteas: genus *Mimetes*. 1986. G.C. van den Berg

POT PLANTS/POTPLANTE

• *Physiology/Fisiologie*

- GS.2432/03/1/1: Rapid multiplication of bulb flower pot plants *in vitro*: *Lachenalia*. 1982. J.G. Janse van Rensburg
- GS.2432/03/1/3: Rapid multiplication of bulb flower pot plants *in vitro*: *Amaryllis*. 1987. M. de Bruyn
- GS.2432/03/1/4: Rapid multiplication of bulb flower pot plants *in vitro*: *Crinum*. 1987. M.M. Slabbert

• *Upgrading/Veredeling*

- GS.2432/07/1/1: Bulb flower pot plants: breeding and selection of *Lachenalia*. 1974. F.L. Hancke
- GS.2432/07/1/2: Pot plants: breeding and selection of intergeneric hybrids of *Amaryllidaceae*. 1987. A.F. Coertze
- GS.2432/07/2/1: Cytogenetical study of bulb flower pot plants: *Lachenalias*. 1983. F.L. Hancke

• *Pathology/Patologie*

- GS.2432/19/1/1: Identification of the virus diseases of bulb flower pot plants: *Lachenalia*. 1981. J.T. Burger

• *Crop science/Gewaskunde*

- GS.2432/30/2/1: Bulb flower pot plants: manipulation of the flowering and growth period of *Lachenalias*. 1984. L. Meyer
- GS.2432/30/2/2: Pot plants: *in vivo* vegetative and corm increasing techniques. 1986. L. Meyer
- GS.2432/30/3/1: Maintenance and multiplication of genetic resources of bulb flower pot plants. 1987. P.J. Klesser
- GS.2432/30/3/2: Collection and description of genetic resources of bulb flower pot plants: *Lachenalias*. 1987. F.L. Hancke
- GS.2432/30/3/3: Collection and description of genetic resources of bulb flower pot plants: *Amaryllidaceae*. 1987. A.F. Coertze

CUT FLOWERS/SNYBLOMME

• *Physiology/Fisiologie*

- GS.2433/03/1/2: Rapid multiplication of bulbous cut flowers *in vitro*: *Ornithogalum maculatum*. 1983. J.G. Janse van Rensburg
- GS.2433/03/1/3: Rapid multiplication of bulbous cut flowers *in vitro*: *Gladiolus*. 1983. M. de Bruyn
- GS.2433/03/1/4: Rapid multiplication of bulbous cut flowers *in vitro*: *Ornithogalum*. 1986. M. de Bruyn
- GS.2433/03/1/5: Rapid multiplication of bulbous cut flowers *in vitro*: *Nerine*. 1986. E. Louw
- GS.2433/03/1/6: Rapid multiplication of bulbous cut flowers *in vitro*: *Cyrtanthus*. 1986. E. Louw
- GS.2433/03/2/1: Embryo culture studies on bulbous cut flowers: *Gladiolus*. 1984. J.G. Janse van Rensburg

- GS.2433/03/2/3: Embryo culture studies on bulbous cut flowers: *Nerine*. 1987. J.G. Janse van Rensburg
- GS.2433/03/2/4: Embryo culture studies on bulbous cut flowers: *Cyrtanthus*. 1987. J.G. Janse van Rensburg

• *Nutrition/Voeding*

- GS.2433/05/1/1: Nutritional needs of bulbous cut flowers: *Ornithogalum*. 1984. A.F. Coertze

• *Upgrading/Veredeling*

- GS.2433/07/1/1: Bulbous cut flowers: breeding and selection of *Ornithogalum*. 1978. F.L. Hancke
- GS.2433/07/1/2: Bulbous cut flowers: breeding and selection of *Gladiolus*. 1983. S.D. Verryin
- GS.2433/07/2/1: Cytogenetical studies of bulbous cut flowers: *Gladiolus*. 1986. S.D. Verryin
- GS.2433/07/3/1: Sterility studies of bulbous cut flowers: *Nerine*. 1986. G. Sorour

• *Pathology/Patologie*

- GS.2433/19/1/2: Herbaceous cut flowers: synthesis and cloning of a C-DNA probe for *Chrysanthemum* stunt viroid. 1985. G.C. Bothma
- GS.2433/19/3/1: Identification of the virus diseases of certain bulbous cut flowers: *Ornithogalum*. 1981. J.T. Burger
- GS.2433/19/3/2: Virus elimination by means of chemotherapy and meristem culture in bulbous cut flowers: *Ornithogalum*. 1984. B.M. Vcelar
- GS.2433/19/5/1: Bulbous cut flowers: study of *Uromyces transversalis* on *Gladiolus*. 1984. J.F. Ferreira
- GS.2433/19/5/2: Bulbous cut flowers: chemical control of *Uromyces transversalis* on *Gladiolus*. 1984. J.F. Ferreira

• *Crop science/Gewaskunde*

- GS.2433/30/1/2: Shrub-like cut flowers: harvesting control of roses by means of pruning practices. 1985. L. Meyer
- GS.2433/30/2/2: Cut flowers: manipulation of the flowering and growth period of *Gladiolus*. 1986. L. Meyer
- GS.2433/30/3/1: Maintenance and multiplication of genetic resources of bulbous cut flowers. 1987. P.J. Klessner
- GS.2433/30/3/2: Collection and description of genetic resources of bulbous cut flowers: *Ornithogalum*. 1987. F.L. Hancke
- GS.2433/30/3/3: Collection and description of genetic resources of bulbous cut flowers: *Gladiolus*. 1987. S.D. Verryin

Pome and stone fruits/Kern- en steenvrugte

APPLES/APPELS

• *Physiology/Fisiologie*

- VV.2441/03/2/3: A test for the occurrence of specific replant diseases of apples. 1982. H.J. van Zyl
- VV.2441/03/4/2: Effect of different nitrogen sources on the utilisation of nitrogen fertilisers by apples. 1985. J.M. de Villiers

- VV.2441/03/5/3: Ethylene synthesis as a maturity index for apples. 1987. S.J. van Eeden
- VV.2441/03/6/7: The influence of nitrogen and potassium nutrition on the synthesis of organic acids and the incidence of bitterpit in apples. 1983. J.F. de Villiers
- VV.2441/03/6/10: The mechanism of action of rest-breaking agents in apples. 1986. M.S. North
- VV.2441/03/6/11: Control of delayed foliation of apples. 1986. M.S. North
- VV.2441/03/6/12: Optimisation of diphenylamine treatment of apples for control of superficial scald. 1988. S. van Eeden
- VV.2441/03/6/13: Stem en russetting of apples. 1986. H.J. van Zyl

• *Nutrition/Voeding*

- VV.2441/05/1/5: Determination of the lime requirement of apple orchard soils and the mobility of surface-applied lime in soils. 1984. H. Gerber
- VV.2441/05/2/6: Seasonal distribution of nitrogen and potassium fertilisation for apple trees. 1985. C.M. Olivier
- VV.2441/05/2/7: Effect of nitrogen potassium and phosphate fertilisation practices on the fruit quality of apples. 1985. C.M. Olivier

• *Upgrading/Veredeling*

- VV.2441/07/1/2: Breeding of apple cultivars resistant to scab. 1977. J.H. Acker
- VV.2441/07/1/7: Development of Granny Smith apple plants from callus and single cells for use in mutation breeding. 1985. R.E. Pieterse

• *Pathology/Patologie*

- VV.2441/19/1/2: Investigation of curative and protective characteristics of existing and new fungicides for apple scab control. 1981. W.F.S. Schwabe
- VV.2441/19/1/6: Isolation techniques for collar and root rot pathogens of apples. 1985. W.A. Smit
- VV.2441/19/1/9: Nature and extent of core rot of apples in the Western Cape. 1988. S.L. de Kock
- VV.2441/19/2/2: Etiology of blister bark of apples. 1987. E.L. Mansveldt

• *Pests/Plae*

- VV.2441/20/1/3: Bionomics of codling moth on apples. 1982. T.L. Blomefield
- VV.2441/20/2/1: Monitoring systems for pest mites and a mite predatory beetle on apples. 1981. J.H. Botha
- VV.2441/20/2/2: Monitoring systems for pest mites and a mite predatory beetle on apples. 1981. M.A. Venter
- VV.2441/20/3/1: Survey of the different nematode species occurring in Western Cape apple orchards. 1979. H.J. Hugo
- VV.2441/20/3/2: Chemical control of nematodes attacking apple trees. 1980. H.J. Hugo

• *Crop science/Gewaskunde*

- VV.2441/30/1/1: The planting and maintenance of apple cultivars. 1972. J.V. Hadlow
- VV.2441/30/1/2: Second phase evaluation of apple cultivars in the Western Cape. 1971. P.R. Jolly
- VV.2441/30/4/1: Fruit size in apples. 1971. O. Bergh

VV.2441/30/6/2: Effect of grass and leguminous cover crops on the performance of apple trees. 1986. R.E. Harris

• *Water requirements/Waterbehoefte*

VV.2441/31/1/2: Effect of irrigation scheduling and soil moisture regime on the yield and quality of apples. 1985. W.A.G. Kotze

VV.2441/31/1/3: Effect of irrigation system, irrigation schedule and soil management on root development of apple tree and utilisation of applied water. 1985. J.H.M. Karsten

• *Meteorology/Weerkunde*

VV.2441/33/1/3: Apples: development of a model for the calculation of the optimum date of application of rest-breaking materials. 1986. M.S. North

VV.2441/33/1/4: Effect of artificial shading on yield and fruit quality of apples. 1986. O. Bergh

• *Technology/Tegnologie*

VV.2441/52/1/4: Effect of ethylene on apple quality during controlled-atmosphere storage. 1987. A.B. Truter

• *Chemistry/Chemie*

VV.2441/53/1/2: Composition and nutritive value of apples. 1984. J.A.G. van Rhyn

PEARS/PERE

• *Physiology/Fisiologie*

VV.2442/03/2/2: Growth control of pears with growth retardants. 1982. H.J. van Zyl

VV.2442/03/2/3: Development of a test for specific replant disease of pears. 1987. S.H. Nolte

VV.2442/03/5/4: Anatomical study of poor keeping quality of Bon Chretien pears. 1984. P. van der Merwe

• *Nutrition/Voeding*

VV.2442/05/1/1: Pears: determination of the effect of soil pH and of potassium and nitrogen fertilisation on the growth, yield and fruit quality of pears. 1982. J. Wooldridge

• *Upgrading/Veredeling*

VV.2442/07/1/1: Breeding of precocious late pear cultivars. 1977. J.H. Acker

VV.2442/07/1/4: Mutation breeding *in vitro* of Packham's Triumph pear to develop a compact growth habit. 1985. R.E. Pieterse

• *Pathology/Patologie*

VV.2442/19/1/2: Factors affecting the development of calyx-end rot of pears. 1985. S.L. de Kock

• *Pests/Plae*

VV.2442/20/1/1: Chemical control of codling moth on pears. 1977. T.L. Blomefield

● *Crop science/Gewaskunde*

- VV.2442/30/1/1: The planting and maintenance of pear cultivars. 1970. P.F. Louw
- VV.2442/30/1/2: Second phase evaluation of pear cultivars in the winter rainfall area. 1971. P.R. Jolly
- VV.2442/30/2/1: Evaluation of pear rootstocks in the winter rainfall area. 1971. P. van Huyssteen
- VV.2442/30/3/1: Increasing production of pears. 1978. P. van Huyssteen
- VV.2442/30/3/2: Comparison of training systems for pears in the Groot-Drakenstein area. 1983. P. van Huyssteen
- VV.2442/30/6/1: Effect of the characteristics of ridges on the performance of pear trees. 1986. J. Wooldridge

● *Technology/Tegnologie*

- VV.2442/52/1/1: Controlled-atmosphere storage of pears. 1982. A.B. Truter
- VV.2442/52/1/3: Ripening of pears. 1988. T.R. Visagie

PEACHES/PERSKES

● *Physiology/Fisiologie*

- VV.2443/03/4/3: Investigation of the physiological causes of woolliness of peaches. 1983. L.E. Rhode
- VV.2443/03/4/4: Factors which cause pit burn and internal breakdown in peaches. 1984. W.A.G. Kotze
- VV.2443/03/4/6: Effect of ring barking at pip hardening on fruit development, fruit quality and carbohydrate composition of Culemborg and Armking peach trees. 1968. H. de Villiers
- VV.2443/03/5/1: Effect of stress conditions on uptake of nutrient elements by peach seedlings. 1987. A. Rabie

● *Nutrition/Voeding*

- VV.2443/05/1/2: Scheduling of nitrogen application through the irrigation system for peaches (nectarines). 1982. K.D. Fuller
- VV.2443/05/1/3: Practical manipulations to increase the urease activity of sandy soils in peach orchards. 1985. M.E. Joubert
- VV.2443/05/1/4: Rate and depth of nitrogen leaching in peach orchard soils with micro-irrigation. 1984. K.D. Fuller
- VV.2443/05/1/5: Seasonal distribution of nitrogen and potassium fertilisation of peach trees. 1988. M.E. Joubert

● *Upgrading/Veredeling*

- VV.2443/07/1/5: Breeding improved peach and nectarine cultivars that are adapted to the various production areas of South Africa. 1984. J.H. Acker
- VV.2443/07/1/6: Embryo culture of peaches. 1986. L.A. Allerman
- VV.2443/07/1/7: Pollen culture of peaches. 1986. L.A. Allerman

● *Pathology/Patologie*

- VV.2443/19/1/1: Post-harvest decay of peaches in the summer rainfall area. 1988. J.F. Fourie

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- SS.2481/30/2/8: Citrus cultivars and selections - early and late maturing navels. 1977. C.F. Human
- SS.2481/30/2/9: Citrus cultivars and selections - easy peelers. 1972. J. Bredell
- SS.2481/30/2/11: Conservation and evaluation of genetic material. 1984. H.J. Breedt
- SS.2481/30/4/1: Nursery techniques involved in propagation of citrus trees. 1972. P.J. Müller
- SS.2481/30/7/1: High density planting of citrus - navels, Valencias and grapefruit. 1985. H.J. Breedt
- SS.2481/30/7/2: Dwarfing of citrus trees. 1985. H.J. Breedt
- SS.2481/30/8/1: Fruit size studies of citrus/Clementines. 1985. P.J.J. van Rensburg

• *Water requirements/Waterbehoefies*

- SS.2481/31/1/1: Water requirements of citrus at Nelspruit. 1968. S.F. du Plessis

- SS.2481/31/1/2: Water requirements of citrus at Addo. 1976. S.F. du Plessis
- SS.2481/31/1/3: Water requirements of citrus with reference to grapefruit in the Malelane area. 1987. S.F. du Plessis
- SS.2481/31/1/4: Water requirements of citrus in the Citrusdal area: navels. 1988. S.F. du Plessis
- SS.2481/31/1/5: Water requirements of citrus in the Addo area: Valencias. 1988. S.F. du Plessis

• *Chemistry/Chemie*

- SS.2481/53/1/1: Enzymatical reactions involved with greening disease in citrus under orchard conditions. 1985. L.J. van Lelyveld
- SS.2481/53/1/2: Enzymatical reactions for greening disease in citrus tissue culture. 1985. L.J. van Lelyveld

PINEAPPLES/PYNAPPELS

• *Physiology/Fisiologie*

- SS.2482/03/1/1: Development of tissue culture techniques for the production of embryonic callus and protoplasts in pineapples. 1984. M. Fitchet
- SS.2482/03/1/2: Clonal propagation of pineapples *in vitro*. 1984. M. Fitchet

• *Nutrition/Voeding*

- SS.2482/05/1/1: Nutritional requirements of pineapples in the Eastern Cape Region. 1972. D.B. Dalldorf
- SS.2482/05/1/2: Macro-element fertilisation of pineapples in Zululand. 1972. G. Smart

• *Pathology/Patologie*

- SS.2482/19/1/1: Control of Phytophthora damage on pineapples in the Eastern Cape. 1986. D.B. Dalldorf

• *Pests/Plae*

- SS.2482/20/1/1: Preventative and corrective control of soil insects in pineapples. 1986. G.J. Petty
- SS.2482/20/1/2: Control of leaf and fruit insects on pineapples. 1974. G.J. Petty
- SS.2482/20/1/3: The possible roll of different pests regarding the occurrence of wilt in pineapples. 1986. P. Willers

• *Crop science/Gewaskunde*

- SS.2482/30/1/4: Evaluation of mulching for pineapples. 1978. E.R. Dalldorf
- SS.2482/30/1/6: Plant density and spacing for smooth Cayenne pineapples. 1986. E.R. Dalldorf
- SS.2482/30/1/7: Evaluation of new herbicides for use in pineapples. 1986. E.R. Dalldorf
- SS.2482/30/1/8: Evaluation of flower inductants on pineapples. 1987. D.B. Dalldorf
- SS.2482/30/2/2: Selection and evaluation of smooth Cayenne pineapples in the Eastern Cape. 1988. E.R. Dalldorf

• *Water requirements/Waterbehoefstes*

- SS.2482/31/1/1: Influence of irrigation on pineapple production. 1981. A.J. Alberts

AVOCADO/AVOKADO

• *Physiology/Fisiologie*

- SS.2483/03/1/4: Radioimmunoassay to determine true hormonal status of etiolated avocado stems. 1981. J.G.M. Cutting
- SS.2483/03/1/5: Radioimmunoassay to determine the hormonal status of alternate bearing avocado trees. 1981. J.G.M. Cutting
- SS.2483/03/2/2: Development of a shoot tip grafting technique in avocados. 1984. M. Nel
- SS.2483/03/3/1: Physiological indicators for the prediction of quality of avocados. 1985. J.P. Bower
- SS.2483/03/3/2: Physiological indicators for the prediction of final harvest date of avocados. 1985. J.P. Bower

• *Nutrition/Voeding*

- SS.2483/05/1/1: Macro- and micro-element requirements of avocados. 1970. T.J. Koen

• *Upgrading/Veredeling*

- SS.2483/07/1/1: Selection of rootstock/scion combinations in avocados. 1985. B.J. Durand

• *Pathology/Patologie*

- SS.2483/19/1/2: Resistance of avocado cultivars to root rot. 1972. J.A. Herbert
- SS.2483/19/1/3: Chemical control of avocado root rot. 1984. J.A. Herbert
- SS.2483/19/2/1: Identification and control of avocado virus diseases. 1968. S.P. van Vuuren
- SS.2483/19/3/1: Control of fruit diseases of avocado by means of antagonistic Phylloplane micro-organisms. 1987. B.Q. Manicom

• *Crop science/Gewaskunde*

- SS.2483/30/1/1: Evaluation of avocado cultivar combinations in Natal. 1985. B.J. Durand

BANANAS/PIESANGS

• *Physiology/Fisiologie*

- SS.2484/03/2/1: Development of tissue culture techniques for the production of embryogenic callus and protoplasts in bananas. 1985. M. Fitchet
- SS.2484/03/3/1: Influence of climatic factors and water stress on physiological responses of banana. 1986. J.C. Robinson

• *Nutrition/Voeding*

- SS.2484/05/1/1: Optimum leaf analysis for bananas. 1970. B.L. Smit

• *Upgrading/Veredeling*

- SS.2484/07/1/1: The evaluation of promising banana selections. 1968. J.C. Robinson

• *Pathology/Patologie*

- SS.2484/19/1/1: Control of Panama wilt in bananas. 1976. J.A. Herbert

- *Pests/Plae*

- SS.2484/20/1/1: Nematodes attacking bananas with special reference to the burrowing nematodes. 1972. E.C. Rabie

- *Crop science/Gewaskunde*

- SS.2484/30/1/1: Determination of optimal plant population and spatial arrangements for bananas. 1980. J.C. Robinson
- SS.2484/30/1/2: Crop timing and forecasting with bananas in relation to time of planting, sucker selection, spacing and locality. 1980. J.C. Robinson
- SS.2484/30/1/3: Commercial evaluation of tissue-cultured banana plants. 1987. J.C. Robinson

- *Water requirements/Waterbehoefte*

- SS.2484/31/1/1: Investigation of irrigation schedules and systems for bananas. 1981. J.C. Robinson
- SS.2484/31/1/2: A critical comparative evaluation of drip and micro-irrigation for bananas. 1986. J.C. Robinson

- *Technology/Tegnologie*

- SS.2484/52/1/1: Improvement of the shelf-life of bananas. 1975. D.H. Swarts
- SS.2484/52/1/2: Controlled-atmosphere storage of bananas. 1983. D.H. Swarts

DIVERSE SUBTROPICAL FRUITS/ALLERLEI SUBTROPIESE VRUGTE

- *Anatomy/Anatomie*

- SS.2485/02/1/2: Propagation biology in diverse subtropical fruits: the mango. 1984. P.D.F. Mullins
- SS.2485/02/1/3: Flower and fruit development of diverse subtropical fruits with relation to papayas. 1985. A.D. Sippel
- SS.2485/02/1/4: Diverse subtropical fruits: phenology in relation to guava. 1987. R.J. du Preez
- SS.2485/02/1/5: Effect of rootstock and climate factors on fruit morphogenesis in granadilla. 1987. A.J. Joubert

- *Physiology/Fisiologie*

- SS.2485/03/1/1: Diverse subtropical fruits: flower and fruit development with relation to mangoes. 1972. P.D.F. Mullins
- SS.2485/03/2/2: Diverse subtropical fruits: development of a shoot tip grafting technique for granadillas. 1985. M. Nel
- SS.2485/03/2/3: Diverse subtropical fruits: development of tissue culture techniques for the production of embryonic callus and protoplasts in mangoes. 1985. G.W. de Winnaar
- SS.2485/03/2/4: Diverse subtropical fruits: clonal propagation of papayas *in vitro*. 1985. G.W. de Winnaar
- SS.2485/03/2/5: Diverse subtropical fruits: development of tissue culture techniques for the production of embryonic callus, protoplasts and haploid plants in papaya. 1985. G.W. de Winnaar

- *Nutrition/Voeding*

- SS.2485/05/1/2: Diverse subtropical fruits: macro- and micro-element requirements of guavas. 1981. T.J. Koen

SS.2485/05/1/5: Diverse subtropical fruits: macro- and micro-element requirements of mangoes. 1972. B.L. Smith

• *Upgrading/ Veredeling*

SS.2485/07/1/2: Diverse subtropical fruits: breeding and selection of relation to mangoes. 1971. J.C. Snyman

SS.2485/07/1/3: Diverse subtropical fruits: breeding and selection of relation to guavas. 1970. C.P. Welgemoed

SS.2485/07/1/4: Diverse subtropical fruits: breeding and selection of relation to litchis. 1981. A.J. Joubert

SS.2485/07/1/5: Upgrading of maroela. 1982. A.J. Joubert

• *Pathology/ Patologie*

SS.2485/19/1/1: Diseases of diverse subtropical fruits: life cycle and control of bacterial black spot of mangoes. 1972. A. Oosthuizen

SS.2485/19/1/4: Diverse subtropical fruits: control of Malelane dieback in guavas. 1982. N.M.G. Grech

• *Pests/ Plae*

SS.2485/20/1/1: Diverse subtropical fruits: the occurrence and control of known and new pests. 1972. E.A. de Villiers

SS.2485/20/1/2: Occurrence and control of plant parasitic nematodes in diverse subtropical fruit: mangoes. 1986. P. Willers

• *Crop science/ Gewaskunde*

SS.2485/30/1/3: Diverse subtropical fruits: alternative pruning systems with relation to guavas. 1985. A.J. Alberts

SS.2485/30/1/4: Pruning of diverse subtropical fruits: litchis. 1987. A.J. Joubert

SS.2485/30/2/1: Testing of diverse subtropical fruits in different localities. 1983. A.J. Joubert

• *Water requirements/ Waterbehoefies*

SS.2485/31/1/1: Water requirements of diverse subtropical fruit: guavas in the summer rainfall area. 1987. T. Anderson

• *Chemistry/ Chemie*

SS.2485/53/1/1: Diverse subtropical fruits: nature and relative occurrence of factors affecting growth in mango flowers with malformation. 1985. J.N. Moll

OTHER SUBTROPICAL CROPS/ANDER SUBTROPIESE GEWASSE

• *Nutrition/ Voeding*

SS.2486/05/1/1: Other subtropical crops: macro- and micro-element requirements of tea. 1975. B.L. Smith

• *Upgrading/ Veredeling*

SS.2486/07/1/1: Other subtropical crops: breeding and selection of tea. 1971. J.C. Snyman

SS.2486/07/1/2: Breeding and selection of other subtropical crops: coffee. 1987. A.C. Nel

• *Pests/Plae*

SS.2486/20/2/1: Other subtropical crops: occurrence and control of root-knot nematode species (*Meloidogyne*) infesting ginger. 1985. P. Willers

SS.2486/20/2/2: Other subtropical crops: integrated control of coffee pests with the emphasis on *Antestiopsis orbitalis* (Westw.). 1986. H. van der Meulen

• *Crop science/Gewaskunde*

SS.2486/30/1/1: Planting distances for other subtropical crops with relation to coffee. 1980. K.F.M.T. de Rooster

SS.2486/30/2/1: Testing of other subtropical crops in different localities. 1975. A.J. Joubert

• *Meteorology/Weerkunde*

SS.2486/33/1/1: Climate manipulation for other subtropical crops: ginger. 1987. T. Anderson

• *Technology/Tegnologie*

SS.2486/52/1/1: Other subtropical crops: effect of field practice and factory processes on black tea quality. 1984. L.J. van Lelyveld

SS.2486/52/2/1: Post-harvest handling of other subtropical crops: ginger. 1986. D.H. Swarts

• *Chemistry/Chemie*

SS.2486/53/1/1: Other subtropical crops: browning potential of tea clones and seedlings. 1984. L.J. van Lelyveld

Nut crops/Neutgewasse

NUTS/NEUTE

• *Nutrition/Voeding*

SS.2491/05/1/1: Macro- and micro-element requirements of macadamia nuts. 1968. R.A. Abercrombie

• *Pathology/Patologie*

SS.2491/19/2/1: Chemical control of anthracnose in macadamias. 1984. N.M. Grech

• *Pests/Plae*

SS.2491/20/1/1: The occurrence and control of pests on nut crops. 1972. E.A. de Villiers

SS.2491/20/1/2: Biological control of stink bugs in macadamia nut orchards. 1987. I.J. Bruwer

• *Crop science/Gewaskunde*

SS.2491/30/1/2: Testing of pecan nut cultivars. 1971. A.J. Joubert

SS.2491/30/2/1: Testing of planting distances of macadamia nuts. 1971. J.H. Oosthuysen

SS.2491/30/3/1: Tree respons to pruning and manipulation of nut trees: pecan nut trees. 1987. J.H. Oosthuysen

- SS.2491/30/3/2: Tree response to pruning and manipulation of nut trees: macadamia trees. 1987. J.H. Oosthuysen
- VV.2491/30/1/1: Second phase evaluation of almond cultivars in the Western Province. 1971. E.J. van Zyl
- VV.2491/30/1/2: Nuts: evaluation of pecan nut cultivars in the High- and Middleveld of Transvaal. 1983. T.K. Haulik
- VV.2491/30/1/3: Nuts: second phase evaluation of almond cultivars in the summer rainfall area. 1987. R.A.W. Gardner

Radioisotopes/Radioisotope

RADIOISOTOPY/RADIOISOTOPIE

● *Chemistry/Chemie*

- VV.24101/53/1/2: Radiochemical separation of 28 Mg and 28 Al in a radioisotope generator. 1983. H. Gerber

Sundry horticultural crops/Diverse tuinbougewasse

HORTICULTURAL CROPS/TUINBOUGEWASSE

● *Nutrition/Voeding*

- VV.24111/05/1/2: Horticultural crops: nitrogen, potassium and boron fertilisation of olives. 1981. K. Bothma
- VV.24111/05/1/3: Horticultural crops: seasonal uptake of mineral nutrients by olive trees. 1987. J.F. de Villiers
- VV.24111/05/3/1: Horticultural crops: seasonal uptake of nutrient elements by kiwi fruit. 1983. J.F. de Villiers
- VV.24111/05/3/2: Horticultural crops: nitrogen and potassium fertiliser requirement of kiwi fruit. 1987. L. Carstens

● *Crop science/Gewaskunde*

- GS.24111/30/1/1: Chemical weed control studies with the horticultural crop: guayle. 1981. H.A. Dafel
- GS.24111/30/2/1: Cultivation studies with the horticultural crop: guayle. 1983. H.A. Dafel
- GS.24111/30/3/1: Evaluation of different cultivars and breeding lines of the horticultural crop guayle under dryland conditions. 1981. H.A. Dafel
- VV.24111/30/1/1: Horticultural crops: evaluation of imported olive cultivars in the Paarl, Clanwilliam and Robertson areas. 1981. C. Costa
- VV.24111/30/1/2: Horticultural crops: evaluation of olive mutations and seedlings in the Paarl and Robertson areas. 1982. C. Costa
- VV.24111/30/1/3: Horticultural crops: evaluation of olive rootstocks in the Paarl and Robertson areas. 1982. C. Costa
- VV.24111/30/1/11: Horticultural crops: evaluation of prickly pear cultivars and selection for the Transvaal. 1987. T.K. Haulik
- VV.24111/30/2/1: Horticultural crops: planting and training systems for olives. 1982. C. Costa
- VV.24111/30/2/2: Horticultural crops: crop control of olives in the Paarl area. 1982. C. Costa
- VV.24111/30/5/1: Horticultural crops: evaluation of cultivars and selections of dates. 1984. C.W.J. Bester

- VV.24/11/30/7/1: Second phase evaluation of fig cultivars in the Western Province. 1974. E.J. van Zyl
- VV.24/11/30/8/1: Horticultural crops: second and third phase evaluations of kiwi fruit cultivars in the Western and Southern Cape. 1977. G.C. Linsley-Noakes
- VV.24/11/30/8/2: Horticultural crops: second and third phase evaluation of kiwi fruit cultivars and selections in the summer rainfall area. 1985. L.L. van der Merwe
- VV.24/11/30/10/2: Horticultural crops: artificial rest breaking of kiwi fruit by climatological and chemical manipulation. 1984. G.C. Linsley-Noakes

• *Water requirements/Waterbehoefte*

- VV.24/11/31/3/1: Horticultural crops, consumptive water use of kiwi fruit. 1988. O. Beukes

• *Technology/Tegnologie*

- VV.24/11/52/1/2: Horticultural crops: processing methods of olives. 1988. P.C. Fourie

PLANT PROTECTION RESEARCH/PLANTBESKERMINGSNAVORSING

Entomology/Zoology/Insektekunde/Dierkunde

INSECTS/INSEKTE

• *Taxonomy/Taksonomie*

- PB.2511/01/1/1: Collection of southern African insects. 1910. G.L. Prinsloo
- PB.2511/01/1/5: Taxonomy of parasitic wasps, Chalcidoidea. 1970. G.L. Prinsloo
- PB.2511/01/1/7: Taxonomy of Neuroptera. 1977. M.W. Mansell
- PB.2511/01/1/9: Taxonomy of Hymenoptera Aculeata. 1978. C.D. Eardly
- PB.2511/01/1/10: Taxonomy of Cicadellidae of southern Africa. 1973. G.L. Prinsloo
- PB.2511/01/1/11: Taxonomy and distribution of weevils (Curculionidae) in southern Africa. 1985. R.G. Oberprieler
- PB.2511/01/1/12: Taxonomy and distribution of Aphidoidea and Coccoidea in southern Africa. 1985. I.M. Millar

• *Pests/Plae*

- PB.2511/20/1/1: Migratory locust control by aerial spray application. 1981. H.D. Brown
- PB.2511/20/1/2: The outbreak dynamics of the African migratory locust. 1981. H.D. Brown
- PB.2511/20/1/3: Aspects of reproduction of *Locustana migratoria* in relation to ageing and available food. 1985. H.D. Brown
- PB.2511/20/2/1: Insects: predators of the harvester termite, *Hodotermes mossambicus*. 1984. Anette Nel
- PB.2511/20/2/2: Insects: bat-eared jackals (*Otocyon megalotis*) as consumers of harvester termites (*Hodotermes mossambicus*). 1984. Anette Nel
- PB.2511/20/2/3: Insects: evaluation of insecticides for use in baits against the harvester termite. 1985. Anette Nel
- PB.2511/20/2/4: Aspects of the population dynamics of the harvester termite *Hodotermes mossambicus* in the Bloemfontein district. 1985. Anette Nel
- PB.2511/20/2/5: The effect of termites on the natural veld in the Bloemfontein district. 1986. Anette Nel
- PB.2511/20/2/6: Insects: food preference of harvester termites and possible bait improvement. 1987. F.D. Duncan

• *Biological control/Biologiese beheer*

PB.2511/22/2/1: The use of natural enemies to control stalk borers in cereal crops. 1978. A.R. Kfir
PB.2511/22/3/1: Development of a computerised datasystem for insect pests and their natural enemies. 1983. H. van Hamburg
PB.2511/22/3/2: Handling and regulation of imported natural enemies of insect pests under quarantine conditions. 1983. H. van Hamburg

• *Integrated control/Geïntegreerde beheer*

PB.2511/23/1/2: The effect of pesticides applied under field conditions against *H. armiger* on natural enemies and red spider mite. 1978. J.D. Mohr
PB.2511/23/1/5: The use of natural enemies to control *H. armiger*. 1978. H. van Hamburg
PB.2511/23/1/6: The feeding behaviour of *Heliothis armiger* larvae and their impact on host plants. 1983. S.J. van der Walt
PB.2511/23/3/1: Evaluation of insecticides against insects which attack the spineless cactus. 1983. M.W. Pretorius

NEMATODES/AALWURMS

• *Taxonomy/Taksonomie*

PB.2512/01/1/1: Collection of nematodes in southern Africa. 1962. Esther van den Berg
PB.2512/01/1/3: Taxonomy of root-knot nematodes, *Meloidogyne* spp. 1981. K.P.N. Kleynhans
PB.2512/01/1/4: Taxonomic study of the South African Longidoridae. 1976. Esther van den Berg

MITES/MYTE

• *Taxonomy/Taksonomie*

PB.2513/01/1/1: Collection of mites of agricultural importance. 1959. Magdalena K.P. Meyer
PB.2513/01/1/2: Taxonomy and biology of predacious mites in South Africa. 1962. E.A. Ueckermann
PB.2513/01/1/3: Taxonomy of free-living Acari in South African soils. 1976. Magdalena K.P. Meyer

• *Integrated control/Geïntegreerde beheer*

PB.2513/23/1/1: Integrated control of spider mite species of agronomic crops. 1986. N.C.J. Basson

SPIDERS/SPINNEKOPPE

• *Taxonomy/Taksonomie*

PB.2514/01/1/1: Taxonomy of agriculturally important spiders. 1976. A.S. Dippenaar

HONEY-BEE/HEUNINGBY

• *Nutrition/Voeding*

PB.2516/05/1/2: Nectar and pollen flora of South Africa. 1969. M.F. Johannsmeier
PB.2516/05/1/3: The effect of *Drosophila* spp. on the nectar supply of eucalyptus flowers. 1983. A.P. du Toit

- *Upgrading/ Veredelings*

PB.2516/07/1/1: The selection of improved breeding lines of honey-bees. 1972. R.H. Anderson

- *Pathology/ Patologie*

PB.2516/19/1/1: Diseases of the adult honey-bee. 1976. B. Buys

- *Behavioural studies/ Gedragstudies*

PB.2516/28/1/1: The behaviour of honey-bees in orchards during pollination. 1972. R.H. Anderson

- *Pollination/ Bestuiwing*

PB.2516/29/1/1: The effect of honey-bees on sunflower pollination. 1985. A.P. du Toit

STORED GRAIN/OPGEBERGDE GRAAN

- *Pests/ Plae*

PB.2518/20/1/1: The use of contact material to control insects in stored grain and grain products. 1955. J.H. Viljoen

PB.2518/20/1/2: The use of poisonous and inert gasses to control storage pests. 1959. J.H. Viljoen

PB.2518/20/1/4: The biology, distribution and identification of the genera *Trogoderma* and *Phradonoma* (Coleoptera: Dermestidae) in stored grain in South Africa. 1987. M. Jonsson

FOREST AND TIMBER/BOSBOME EN TIMMERHOUT

- *Pests/ Plae*

PB.2519/20/1/1: The biology, fungal associations and control of bark beetles on pine trees. 1979. G.D. Tribe

PB.2519/20/1/2: The control of timber insects. 1955. J.K. Winstanley

PB.2519/20/1/3: The biology, pest status and control of the black pine aphid. 1977. N.J. van Rensburg

PB.2519/20/1/4: Forest and timber: the biology of the pine woolly aphid. 1982. A.J. Urban

PB.2519/20/1/5: Forest and timber: the biology and behaviour of natural enemies of pine aphids. 1984. J.F. Kirsten

PB.2519/20/1/6: Forest and timber: seasonal behaviour of natural enemies of pine aphids. 1984. J.K. Winstanley

PB.2519/20/1/7: Forest and timber: biology and control of beetle pests of *Eucalyptus* spp. 1984. G.D. Tribe

PB.2519/20/1/8: The biology of insect pests of furniture timber plantations. 1986. J.F. Morrison

PB.2519/20/1/9: The ecology and control of termites in forestry plantation. 1987. P.R. Atkinson

Plant pathology/Microbiology/Plantpatologie/Mikrobiologie

FUNGI/SWAMME

- *Taxonomy/ Taksonomie*

PB.2521/01/1/1: Identification of diverse fungi. 1973. A.P. Baxter

- PB.2521/01/1/4: Taxonomy of fungi: Coelomycetes of South Africa. 1982. C. Roux
- PB.2521/01/1/5: The species of the fungus genus *Phytophthora* in South Africa. 1982. A.H. Thompson
- PB.2521/01/1/6: Taxonomy of fungi: *Fusarium* species in South Africa. 1984. R.Y. Anelich
- PB.2521/01/2/1: Taxonomy of Ascomycetes: ontogeny of certain loculoascomycetes. 1988. E.J. van der Linde

• *Mycology/Mikologie*

- PB.2521/11/1/1: Examination of diverse feeds for toxigenic fungi. 1978. C. Roux
- PB.2521/11/1/2: Role of toxigenic fungi in the occurrence of hepatogenous photosensitivity in livestock. 1971. C. Roux

• *Pathology/Patologie*

- PB.2521/19/1/2: Seed-borne fungi of dry beans. 1982. A.P. Baxter
- PB.2521/19/2/5: Factors affecting survival, sporulation and infection by the fungus *P. cinnamomi*. 1985. Sharon L. von Broembsen
- PB.2521/19/2/6: Association of the fungus *P. cinnamomi* with decline and mortality of indigenous trees and shrubs. 1985. Sharon L. von Broembsen
- PB.2521/19/2/7: Control of root rot of pin cushions caused by the fungus *P. cinnamomi*. 1985. Sharon L. von Broembsen
- PB.2521/19/4/1: Host range, distribution and pathogenicity of the fungus *B. dothidea*. 1985. J.A. van der Merwe
- PB.2521/19/4/2: Factors affecting sporulation, infection and disease development by the fungus *B. dothidea*. 1985. J.A. van der Merwe
- PB.2521/19/4/3: Control of canker and dieback of cut-flower proteas caused by the fungus *B. dothidea*. 1985. J.A. van der Merwe
- PB.2521/19/5/1: Host range, distribution and pathogenicity of the fungus *D. dematioidea*. 1985. Sharon L. von Broembsen
- PB.2521/19/5/2: Factors affecting sporulation infection and disease development by the fungus *D. dematioidea*. 1985. Sharon L. von Broembsen
- PB.2521/19/5/3: Control of pin cushion blight caused by the fungus *D. dematioidea*. 1986. Sharon L. von Broembsen
- PB.2521/19/6/1: Epidemiology of diseases caused by fungi of the genus *Rhizoctonia*. 1987. A.J.L. Phillips
- PB.2521/19/6/2: Biology of fungi of the genus *Rhizoctonia*. 1987. A.J.L. Phillips
- PB.2521/19/6/3: Evaluation of possible methods for control of diseases caused by *Rhizoctonia*. 1987. A.J.L. Phillips

BACTERIA/BAKTERIEë

• *Nitrogen fixation/Stikstofbinding*

- PB.2522/09/1/1: Testing of commercial bacterial inoculants for legumes. 1967. J.L. Staphorst
- PB.2522/09/1/2: Selection of *Rhizobium* bacteria for inoculants. 1968. C.J. Otto
- PB.2522/09/1/9: Application of nitrogen fixing bacterial inoculants to legumes through irrigation systems. 1983. J.L. Staphorst
- PB.2522/09/1/10: Development of immunological methods for quality control of legume inoculants containing bacteria. 1985. H.H. Lochner
- PB.2522/09/1/11: Bacteria: possible utilisation of liquid *Rhizobium* inoculant. 1985. C.J. Otto

- PB.2522/09/1/12: Bacteria: investigation of problems experienced with inoculation of pasture legumes. 1985. J.L. Staphorst
- PB.2522/09/1/13: Bacteria: investigation of problems experienced with inoculation of grain legumes. 1985. J.L. Staphorst
- PB.2522/09/1/14: Bacteria: production of Indole acetic acid by strains and mutants of *Rhizobium* - possible effects on the host plant. 1986. I.J. Law
- PB.2522/09/1/15: Bacteria: role of lectins in the *Rhizobium*-legume symbiosis. 1986. I.J. Law
- PB.2522/09/1/16: Bacteria: effect of foreign plasmids on the symbiotic properties of *Rhizobium meliloti*. 1986. I.J. Law
- PB.2522/09/1/17: Bacteria: determination of possible genetic changes between soil isolates and laboratory cultures of *Bradyrhizobium* sp. (Lotus). 1986. H.H. Lochner
- PB.2522/09/1/18: Bacteria: competition studies with root nodule bacteria and comparison of isolates of a strain of *Bradyrhizobium* sp. (Lotus) from established soil populations and laboratory cultures. 1986. H.H. Lochner

• *Pathology/Patologie*

- PB.2522/19/1/1: Identification and control of bacterial pathogens of crops from various regions and institutes. 1979. C.C.P.R. Deschodt
- PB.2522/19/1/2: Elimination of seed-borne bacterial pathogens from bean seed. 1974. C.C.P.R. Deschodt
- PB.2522/19/1/3: Bacteria: identification and elimination of bacterial pathogens from soybean cultivars. 1985. C.C.P.R. Deschodt
- PB.2522/19/1/4: Bacteria: identification and elimination of bacterial pathogens from *Brassica* sp. 1985. C.C.P.R. Deschodt
- PB.2522/19/1/5: Bacteria: identification and elimination of bacterial pathogens on Guar. 1985. C.C.P.R. Deschodt
- PB.2522/19/1/6: Bacteria: survey of bacterial pathogens on pasture legumes and determination of host range. 1986. C.C.P.R. Deschodt

• *Biological control/Biologische beheer*

- PB.2522/22/1/1: Bacteria: isolation, identification and biotyping of *Agrobacterium* spp. from plants and soil. 1985. F.G.H. van Zyl
- PB.2522/22/1/2: Bacteria: the determination of agrocin production and sensitivity of local pathogenic and non-pathogenic *Agrobacterium* species. 1985. F.G.H. van Zyl
- PB.2522/22/1/3: Bacteria: the evaluation of D286 as control strain for crown gall where K84 appears to be unsuccessful. 1985. F.G.H. van Zyl
- PB.2522/22/1/4: Bacteria: the role of competition and specificity of the plant cell binding sites in the biological control of crown gall. 1985. J.L. Staphorst
- PB.2522/22/1/5: Bacteria: the role of agrocins in the biological control of crown gall. 1985. J.L. Staphorst
- PB.2522/22/1/6: Bacteria: the determination of factors in the Boland that is responsible for the possible suppression of crown gall on grapevine. 1985. F.G.H. van Zyl
- PB.2522/22/1/7: Development of agrocin producing strains of *Agrobacterium tumefaciens*. 1984. J.L. Staphorst

VIRUSES/VIRUSSE

• *Virology/Virologie*

- PB.2523/12/1/1: Investigation on the virus nature of grapevine leafroll disease. 1985. D.J. Engelbrecht

- PB.2523/12/1/2: Investigations on the mealybug transmission of viruses associated with grapevine leafroll disease. 1985. D.J. Engelbrecht
- PB.2523/12/1/3: Development of immunological virus detection procedures for grapevine diseases. 1985. D.J. Engelbrecht
- PB.2523/12/1/4: Development of nucleic acid coupled virus detection procedures for grapevine diseases. 1985. R. Human
- PB.2523/12/1/5: Detection and identification of seed-transmitted viruses in soybeans. 1985. G. Pietersen
- PB.2523/12/1/6: Detection and identification of seed-transmitted viruses in lupins. 1985. P.M.B. Snyman
- PB.2523/12/1/7: Detection and identification of seed-transmitted viruses in beans. 1986. M.J. Koch

FOREST AND TIMBER/BOSBOME EN TIMMERHOUT

- *Pathology/Patologie*
- PB.2525/19/1/6: Integrated control of forest tree diseases. 1983. A.E. Lundquist
- PB.2525/19/2/1: Forest and timber: pathogenicity host range and spread of *Verticicladiella* spp. causing root diseases of pines. 1985. M.J. Wingfield
- PB.2525/19/3/1: Forest and timber: host range and spread of *Diplodia pinea* on pines in South Africa. 1985. M.J. Wingfield
- PB.2525/19/3/2: Forest and timber: production and liberation of conidia by *Diplodia pinea*. 1985. M.J. Wingfield
- PB.2525/19/4/1: Forest and timber: the occurrence and vector associations of *Ceratocystis* species on forest trees. 1985. M.J. Wingfield
- PB.2525/19/5/1: Forest and timber: host range, pathogenicity and distribution of *Mycosphaerella* needle disease of pines. 1986. M.J. Wingfield
- PB.2525/19/10/1: Forest and timber: routine diagnoses of forest tree diseases in Transvaal. 1985. A.E. Lundquist
- PB.2525/19/10/2: Forest and timber: routine diagnosis of forest tree diseases in the Cape Province and Natal. 1985. M.J. Wingfield

PASTURE CROPS/WEIDINGSGEWASSE

- *Pathology/Patologie*
- PB.2526/19/1/9: Pasture crops: seed-borne fungal pathogens and disease transmission by seed of *Medicago* spp. 1986. S.C. Lamprecht
- PB.2526/19/1/10: Pasture crops: survival and infection of *Fusarium avenaceum* on annual *Medicago* spp. 1986. S.C. Lamprecht
- PB.2526/19/1/11: Pasture crops: the role of *Fusarium* in a wheat-medic crop rotation system. 1986. S.C. Lamprecht
- PB.2526/19/1/12: Pasture crops: yield losses by and resistance to *Colletotrichum* crown rot of lucerne cultivars in the Cape Province. 1985. S.H. Koch
- PB.2526/19/1/13: Pasture crops: assessment of disease resistance of cultivated lucerne cultivars to above and below ground pathogens in South Africa. 1986. S.C. Lamprecht

Electron microscopy/Elektronmikroskopie

ELECTRON MICROSCOPY/ELEKTRONMIKROSKOPIE

- *Technology/Tegnologie*
- PB.2541/52/1/1: Preparation and examination of biological specimens by electron microscopy. 1979. H.J. van Tonder

Weed research/Onkruidnavorsing

WEEDS/ONKRUIDE

• Physiology/Fisiologie

- PB.2551/03/1/1: Physiology of veld invader weeds' seed germination. 1981. P.L. Campbell
 PB.2551/03/2/1: Uptake and translocation of herbicides by the weed bramble (*Rubus* spp.). 1981. D.J. Erasmus
 PB.2551/03/2/2: Eco-physiology of jointed cactus (*Opuntia aurantiaca*). 1984. S. Naser

• Chemical control/Chemiese beheer

- PB.2551/21/1/1: Chemical control of the weed jointed cactus (*Opuntia aurantiaca*). 1960. H.G. Zimmermann
 PB.2551/21/1/2: Chemical control of the weed nassella tussock (*Stipa trichotoma*). 1980. G.B. Harding
 PB.2551/21/1/3: Chemical control of the weed mesquite (*Prosopis* spp.). 1983. G.B. Harding
 PB.2551/21/1/4: Chemical control of alien veld invaders in Natal. 1983. D.J. Erasmus
 PB.2551/21/1/5: Chemical control of invader weeds of localised Eastern Cape areas. 1983. B.D. Viljoen
 PB.2551/21/1/7: Chemical control of important weeds and unwanted plants in plantations. 1988. R.P. Denny
 PB.2551/21/1/8: Chemical control of the weed silver leaf bitterapple (*Solanum elaeagnifolium*). 1988. B.D. Viljoen

• Biological control/Biologiese beheer

- PB.2551/22/1/1: Biological control of the weed jointed cactus (*Opuntia aurantiaca*). 1960. H.G. Zimmermann
 PB.2551/22/1/4: Biological control of the weed prickly pear (*Opuntia ficus-indica*). 1960. H.G. Zimmermann
 PB.2551/22/1/5: Biological control of the weed *Lantana camara*. 1972. C.J. Cilliers
 PB.2551/22/1/6: Biological control of the weeds *Hakea sericea*, *H. gibbosa* and *H. saueolens*. 1972. R.L. Kluge
 PB.2551/22/1/7: Biological control of the weed *Hypericum perforatum*. 1972. R.L. Kluge
 PB.2551/22/1/8: Biological control and management of cactus weeds, particularly jointed cactus in South Africa. 1977. S. Naser
 PB.2551/22/1/11: Biological control of undesirable Australian *Acacia* weeds. 1988. G.B. Dennill
 PB.2551/22/1/15: Biological control of the weed spear thistle (*Cirsium vulgare*). 1988. D.J.R. Noel
 PB.2551/22/1/16: Biological control of the weed *Prosopis*. 1988. H.G. Zimmermann
 PB.2551/22/1/17: Biological control of important aquatic weeds. 1988. C.J. Cilliers
 PB.2551/22/1/18: Biological control of the weed silver leaf bitterapple (*Solanum elaeagnifolium*). 1985. H.G. Zimmermann
 PB.2551/22/2/1: A study of the diseases of some indigenous and exotic weeds which are caused by local pathogens. 1979. M.J. Morris
 PB.2551/22/2/2: Biological control of *Acacia* weeds by means of pathogens. 1982. M.J. Morris
 PB.2551/22/2/5: Biological control of diverse weeds with the aid of pathogens. 1988. M.J. Morris

• Integrated control/Geïntegreerde beheer

- PB.2551/23/1/1: Integrated control of the weed *Opuntia aurantiaca* (jointed cactus). 1986. L. Henderson

● *Plant geography/ Plantgeografie*

- PB.2551/25/1/1: A survey of alien invasive trees and shrubs in the grassland and savanna biomes. 1986. L. Henderson

● *Ecology/ Ekologie*

- PB.2551/27/1/1: Ecology of the weed *Acacia longifolia*. 1983. P.J. Pieterse
 PB.2551/27/1/2: Ecology of the weed nassella tussock (*Stipa trichotoma*). 1983. B.D. Viljoen
 PB.2551/27/1/3: Ecology of the weed *Prosopis* spp. 1988. G.B. Harding

PESTICIDES/PLAAGDODERS

● *Physiology/ Fisiologie*

- PB.2552/03/1/1: Interaction between dimethoate and bromacil in citrus orchards. 1984. J.J.M. Meyer
 PB.2552/03/1/2: Effect of pesticide breakdown in soils on phytotoxicity. 1984. E.R.I.C. Sandmann
 PB.2552/03/1/3: A study of climatic factors potentiating pesticide phytotoxicity in legumes. 1984. E. van Rensburg
 PB.2552/03/1/5: Determination of the threshold value for and physiological mechanisms of hormone herbicides in vegetable crops. 1988. L.M. Jordaan

● *Biotesting/ Biotoetsing*

- PB.2552/24/1/1: The use of an algal bioassay to determine concentrations of phytosynthetic-inhibiting herbicides. 1985. J.L. Graaf
 PB.2552/24/1/2: The use of plant cells and plant tissue culture to determine herbicide concentrations. 1985. J.L. Graaf

● *Technology/ Tegnologie*

- PB.2552/52/1/3: Study of physical characteristics of pesticide formulations. 1980. H.A. Abott
 PB.2552/52/1/4: The role of adjuvants in the penetration and effectiveness of pesticides. 1985. L.P. van Dyk
 PB.2552/52/1/5: The role of leaf surfaces in the effectiveness of adjuvants and pesticides. 1986. M.J. York

● *Chemistry/ Chemie*

- PB.2552/53/1/2: Improvement of chromatographic resolution of pesticides. 1981. P.R. de Beer
 PB.2552/53/1/4: Pesticide residues in raw vegetables, fruit and animal products. 1977. L.P. van Dyk
 PB.2552/53/1/5: Analysis of pesticides and their residues affecting useful plants. 1983. P. Niewoudt
 PB.2552/53/1/6: Research and improvement of pesticide analysis done by the WGPA. 1984. P.R. de Beer
 PB.2552/53/1/7: Development of confirmation techniques for pesticide residue analysis. 1985. Marelie Krause

ANIMAL PRODUCTION PROMOTION DIEREPRODUKSIEBEVORDERING

ANIMAL PRODUCTION AND ANIMAL PRODUCTS RESEARCH DIEREPRODUKSIE- EN DIEREPRODUKTENAVORSING

Animal production/Diereproduksie

BEEF CATTLE/VLEISBEESTE

- *Reproduction/Reproduksie*

- VS.3111/04/1/1: Reproduction in beef cattle: biochemical interrelationships during nutritional stress. 1984. G.W. Kay

- *Upgrading/Veredeling*

- VS.3111/07/1/1: Evaluation of beef bulls in upgrading: Bonsmara. 1980. D.J. Bosman
- VS.3111/07/1/2: Beef cattle: evaluation of the Roodebos and Wesselsvlei Bonsmara breeding lines. 1982. D.J. Bosman
- VS.3111/07/1/3: Upgrading studies on beef cattle - improving fertility by natural selection. 1984. M.M. Scholtz
- VS.3111/07/1/4: Upgrading studies on beef cattle: the effects of selection for growth under different management systems on production efficiency. 1985. J. van der Westhuizen
- VS.3111/07/1/5: Upgrading studies on beef cattle: a genetic study of the 1/29 chromosome translocation in the progeny of a heterozygote Brahman bull. 1985. N.D. Nel
- VS.3111/07/1/6: Upgrading studies on beef cattle: the influence of the simulation of natural selection of body mass and fertility in a large beef breed. 1985. M.M. Scholtz
- VS.3111/07/1/7: Beef cattle: prediction of breeding values and quantification of genetic trends using mixed model procedures. 1985. C. Hunlun
- VS.3111/07/1/8: Upgrading studies on beef cattle - the estimation of brain mass by using head measurements of cattle and rats. 1985. H.E. Theron

DAIRY CATTLE/MELKBEESTE

- *Physiology/Fisiologie*

- VS.3112/03/1/1: An investigation into *in vitro* culture techniques for hormone dependent mammary gland tissue in dairy cattle. 1983. J.P. van Zyl
- VS.3112/03/1/2: Milk prolactin surge before and during parturition and production parameters in dairy cattle. 1983. J.P. van Zyl

- *Nutrition/Voeding*

- VS.3112/05/1/3: Ureum in complete diets for dairy cattle. 1982. L.J. Erasmus
- VS.3112/05/1/5: Dairy cattle nutrition: establishment of a degradability database. 1985. L.J. Erasmus
- VS.3112/05/1/7: Dairy cattle nutrition: strategic protein nutrition of high producing cows. 1985. B. Ferreira
- VS.3112/05/1/8: Dairy cattle: the potential of a zeolite (vermiculite) as a buffer in dairy cattle diets. 1986. L.J. Erasmus

VS.3112/05/1/9: Dairy cattle: the *in sacco* digestibility of amino acid of UDP in the small intestine. 1987. L.J. Erasmus

• *Upgrading/ Veredelings*

VS.3112/07/1/3: Milkability and milk quality characteristics in the upgrading of dairy cattle. 1971. J.H. Hofmeyr

• *Management/ Bestuur*

VS.3112/41/1/1: Biological economic data-analysing service for dairy cattle. 1981. B. Ferreira

MUTTON SHEEP/VLEISSKAPE

• *Upgrading/ Veredelings*

VS.3113/07/1/1: Upgrading of mutton sheep: quantification of genetic and non-genetic components of maternal effects. 1985. J.C. Greeff

WOOLLED SHEEP/WOLSKAPE

• *Upgrading/ Veredelings*

VS.3114/07/1/1: Skin and fibre characteristics in the upgrading of woolled sheep. 1972. O. Steinhagen
VS.3114/07/2/1: Upgrading of reproduction characteristics of woolled sheep by means of cross-breeding. 1972. J.H. Hofmeyr
VS.3114/07/2/2: Upgrading of woolled sheep crosses: evaluation of the Gotlander and its crosses for carpet wool production. 1985. J.C. Greeff
VS.3114/07/2/3: Evaluation of selected cross-bred woolled sheep under normal farm conditions in co-operation with co-operative workers. 1985. J.C. Greeff

PELT SHEEP/PELSSKAPE

• *Reproduction/ Reproduksie*

VS.3115/04/1/1: Reproduction aspects in pelt sheep: freezing of Karakul semen. 1971. J.P.C. Greyling

• *Upgrading/ Veredelings*

VS.3115/07/1/1: Upgrading of pelt sheep - white Karakuls. 1980. J.H. Hofmeyr

MEAT GOATS/VLEISBOKKE

• *Reproduction/ Reproduksie*

VS.3117/04/1/1: Reproduction in the Boer goat: freezing of Boer goat semen. 1974. J.P.C. Greyling
VS.3117/04/1/2: Reproduction in the meat goat: Boer goats. 1980. J.P.C. Greyling

PIGS/VARKE

• *Reproduction/ Reproduksie*

VS.3119/04/1/3: Pigs: reproduction in gilts - puberty. 1982. G.W. Kay

VS.3119/04/1/4: Pigs: reproduction in boars - seasonal growth. 1982. G.W. Kay

• *Nutrition/Voeding*

- VS.3119/05/1/5: Pig nutrition: the "ideal protein" requirements of the growing pig. 1984. E.H. Kemm
- VS.3119/05/1/6: Pig nutrition: qualitative and quantitative aspects and implications of wheat as feed source. 1984. F.K. Siebrits
- VS.3119/05/1/7: Alternative feed sources for pigs - class FH sunflower seed. 1985. J. Viljoen
- VS.3119/05/1/9: Pig nutrition: a comparison between the mobile bag technique and the total collection of faeces to determine digestible energy. 1986. N. Slabbert
- VS.3119/05/1/10: Pig nutrition: the effect of thermal ammoniation on the digestibility and utilisation of bird-proof grain sorghum. 1987. T.S. Brand
- VS.3119/05/1/11: Pig nutrition: quantification of the variation in apparent digestible content of sorghum. 1987. T.S. Brand
- VS.3119/05/1/12: Digestive physiology and metabolism aspects in animal feeding: lipid metabolism in the vicinity of the break-point in the growth curve of pigs. 1988. J.P. Minnaar

• *Upgrading/Veredeling*

- VS.3119/07/1/2: Upgrading of pigs: biochemical genetic typing for identification and parentage control. 1985. A. Swanepoel

CHICKENS/HOENDERS

• *Nutrition/Voeding*

- VS.31110/05/1/1: Nutrition of laying fowls - influence of calcium on phosphorus requirements. 1977. J.J. Prinsloo
- VS.31110/05/1/2: Nutrition of laying fowls - lysine requirements. 1976. F.D.C. Labuschagne
- VS.31110/05/1/3: Nutrition of laying fowls - seasonal energy and protein levels. 1975. F.D.C. Labuschagne
- VS.31110/05/1/4: The use of grain sorghum (*Sorghum vulgare*) in chicken diets. 1982. S.J. Davie
- VS.31110/05/1/5: The use of lupins as feed component in poultry diets. 1987. J.J. Prinsloo

• *Upgrading/Veredeling*

- VS.31110/07/1/1: Upgrading of laying fowls - sex-linked feather colour. 1972. J.J. Joubert
- VS.31110/07/1/2: Upgrading of laying fowls - red or gold feather colour. 1971. J.J. Joubert
- VS.31110/07/1/3: Upgrading of laying fowls - combining activity. 1971. J.J. Joubert
- VS.31110/07/1/4: Upgrading of laying fowls - Australorp. 1971. J.J. Joubert
- VS.31110/07/1/5: Upgrading of laying fowls - other breeds. 1972. J.J. Joubert
- VS.31110/07/1/6: Upgrading of laying fowl breeds - New Hampshire control flock. 1976. J.J. Joubert
- VS.31110/07/1/7: Genotype environment interaction in laying fowls - upgrading of laying fowl breeds. 1976. J.J. Joubert
- VS.31110/07/2/1: Upgrading of meat type male line fowls. 1975. J.J. Joubert
- VS.31110/07/2/2: Upgrading of meat type hen line fowls. 1962. J.J. Joubert
- VS.31110/07/2/3: Male and female line genetic control flocks. 1987. J.J. Joubert

OTHER POULTRY/ANDER PLUIMVEE

• *Nutrition/Voeding*

- VS.31115/05/1/1: Nutrient requirement of other poultry - Chinese geese. 1965. J.J. Prinsloo
VS.31115/05/1/2: Nutrient requirement of other poultry feeding systems - ducks. 1977. M.D. Olver

• *Upgrading/Veredeling*

- VS.31115/07/1/1: Upgrading of other poultry - Hagedoorn system with ducks. 1965. M.D. Olver

Animal products/Diereproducte

MEAT/VLEIS

• *Norm studies/Normstudies*

- VS.3121/50/1/2: Meat production: carcass evaluation - cattle. 1975. J.F. de Bruyn
VS.3121/50/1/3: Meat production: chilling of beef carcasses. 1976. P.H. Heinze
VS.3121/50/1/8: Meat production: carcass grading system - small stock. 1981. G.G. Bruwer
VS.3121/50/1/9: Meat production: compensatory growth - cattle. 1982. J.F. de Bruyn
VS.3121/50/1/11: Meat production: porcine stress syndromes. 1984. P.H. Heinze
VS.3121/50/1/12: Meat production: the influence of vacuum packaging films on beef quality. 1984. G.L. Nortjé
VS.3121/50/1/13: Meat production: quality characteristics and cooking losses of beef prepared according to different oven roasting methods. 1986. I.B. Zondach
VS.3121/50/1/14: Meat and meat production norm studies: a comparison of the quality characteristics of goat meat with mutton. 1986. H.C. Schönfeldt
VS.3121/50/1/15: The influence of chilling and other environmental factors on the shelf-life of meat. 1987. G.L. Nortje
VS.3121/50/1/16: A comparison between the agar impression technique, the modified agar impression technique and the excision technique to determine the bacterial contamination of meat. 1987. S.J. Botha
VS.3121/50/1/17: Meat and meat production norm studies: carcass and meat quality characteristics of intact and castrated male cattle. 1987. T. Pietersen
VS.3121/50/2/1: Pork production and meat norm studies: a survey of the carcass characteristics of pig carcasses in the R.S.A. 1987. G.G. Bruwer
VS.3121/50/2/2: Pork and pork production norm studies: the effects of castration and feeding unsaturated oil (sunflower seed) on the fatty acid composition of pig fat (intra- and extra-muscular). 1987. S.M. de Jong
VS.3121/50/2/3: Pork production and meat norm studies: carcass evaluation of cross-bred pigs. 1987. G.G. Bruwer
VS.3121/50/2/4: Meat quality characteristics of cross-bred pigs. 1987 P.H. Heinze
VS.3121/50/2/5: The development of a classification and grading system for pig meat in South Africa. 1987. G.G. Bruwer
VS.3121/50/2/6: Meat quality characteristics as influenced by genotype, slaughter mass and sex type. 1987. P.H. Heinze
VS.3121/50/2/7: Pork fat quality characteristics as influenced by genotype, slaughter mass and sex type. 1987. S.M. de Jong

- VS.3121/50/2/8: The suitability of carcass meats for processing as influenced by genotype, sex type and slaughter mass. 1987. J.C. Venter
- VS.3121/50/2/9: Pork production norm studies: evaluation of sensory characteristics of roasts and processed products as influenced by genotype, sex type and slaughter mass. 1987. I.B. Zondach
- VS.3121/50/3/1: Microbiological and technological properties of fresh pork during slaughtering, deboning, vacuum and gas packaging and distribution. 1987. E.M. Scholtz
- VS.3121/50/4/1: The influence of zinc tannate on sexual development, production and product characteristics of the meat bulls. 1987. P.E. Strydom

MILK/MELK

• Microbiology/Mikrobiologie

- VS.3123/08/1/5: Milk: preservation of milk samples for bacterial count tests. 1983. H. Gavron
- VS.3123/08/2/4: The presence and influence of facultative anaerobic fecal bacteria in milk and milk products. 1987. D. Wessels
- VS.3123/08/3/2: The shelf-life of aseptical-packaged pasteurised milk. 1983. J.F. Mostert
- VS.3123/08/3/4: Presence, isolation and identification of psychrotrophic bacteria in raw milk samples. 1987. G.J. Swart
- VS.3123/08/4/2: Milk: assay of antibiotics. 1983. H. Gavron

• Technology/Tegnologie

- VS.3123/52/2/1: Technological control of the metabolic activity of psychrotrophic bacteria. 1987. G.J. Swart

• Chemistry/Chemie

- VS.3123/53/2/1: Discolourisation of UHT-milk. 1981. B.G. Venter
- VS.3123/53/4/1: Natural and added iodine in milk. 1981. D. Wessels
- VS.3123/53/4/2: Regional and seasonal tendencies and sources of contamination of pesticides in milk products. 1985. L.E. Smit

DAIRY PRODUCTS/SUIWELPRODUKTE

• Microbiology/Mikrobiologie

- VS.3124/08/1/1: Dairy products: a genetic study of the group *N. streptococci*. 1981. H. Gavron
- VS.3124/08/1/3: Dairy products: bacterial content of air in dairy factories. 1983. K. Radmore
- VS.3124/08/1/5: The long chain fatty acid composition as an aid in the identification of the lactic acid streptococci used in commercial starter cultures in South Africa. 1988. H.B. Muller
- VS.3124/08/1/8: The bacteriological composition of commercial cheese starters used in South Africa. 1987. F.S. Botha
- VS.3124/08/2/2: Dairy products: the influence of non-starter organisms on Cheddar cheese. 1983. A.J. Kruger
- VS.3124/08/2/4: Dairy products: the incidence and practical importance of psychrotrophic Enterobacteriaceae in milk and dairy products. 1987. A.L. Malan
- VS.3124/08/3/4: Enterotoxic *Escherichia coli* in dairy products. 1982. H. Gavron
- VS.3124/08/3/5: Dairy products: the evaluation of pathogenic bacteria in milk and cheese. 1983. H. Gavron

- *Norm studies/Normstudies*

- VS.3124/50/1/1: Dairy products: production and quality of butter in South Africa. 1981. J.J. du Toit
- VS.3124/50/1/2: Dairy products: production and quality of ice-cream in South Africa. 1983. J.J. Keller

- *Technology/Tegnologie*

- VS.3124/52/1/1: Dairy products: technique studies in the concentration of whey and skim milk by ultrafiltration. 1983. T.E.H. Downes
- VS.3124/52/1/2: The use of products recovered by ultrafiltration in dairy products. 1972. T.E.H. Downes
- VS.3124/52/1/5: Dairy products: the development of a low-energy dairy spread with favourable spreadability. 1982. T.E.H. Downes
- VS.3124/52/1/6: Dairy products: demineralisation, processing and utilisation of cheese whey. 1982. A.P. Potgieter
- VS.3124/52/1/9: Dairy products: thermisation of milk for the manufacture of cheese. 1984. T.E.H. Downes
- VS.3124/52/1/10: Hydrolysis of lactose in cheese whey for use in dairy products or other foods. 1984. T.E.H. Downes
- VS.3124/52/1/11: Dairy products: the manufacture of cold water instant full-cream milk powder on a two-stage spray dryer. 1985. T.E.H. Downes

- *Chemistry/Chemie*

- VS.3124/53/3/4: Dairy products: the identification of milk proteins in other foods. 1983. B.G. Venter
- VS.3124/53/3/6: Levels of linoleic acid (trans) in dairy products and oils before and after processing. 1984. L.D. Nourse
- VS.3124/53/3/7: Dairy products *versus* processed oils as fat-energy source: the disturbance of the metabolism of all cis-linoleic acid by the transforms as measured by growth of broiler chicks. 1984. L.D. Nourse
- VS.3124/53/3/8: Dairy products *versus* processed oils as fat-energy source: the disturbance of the metabolism of all cis-linoleic acid by the transforms as measured by uncontrolled cell proliferation in tissue cultures. 1984. L.D. Nourse
- VS.3124/53/3/9: The incidence of heavy metals in dairy products. 1985. D.J.W. Bester

Supporting animal research/Ondersteunende veekundige navorsing

ANIMALS/DIERE

- *Reproduction/Reproduksie*

- VS.3133/04/1/2: Animal reproduction: an *in vitro* rat embryo culture bio-assay to detect exogenous teratogens (lead and copper). 1985. J.M. Burgman

- *Nutrition/Voeding*

- VS.3133/05/1/9: Feed intake in the nutrition of farm animals - growth studies with beef steers under production conditions. 1984. J.P. Campher
- VS.3133/05/1/10: Feed intake in the feeding of farm animals: quantification of digestive energy losses on different ruminant diets. 1984. N. Slabbert
- VS.3133/05/1/11: Feed intake parameters in the feeding of farm animals: chromium mordant as a particle marker. 1985. J.P. Pienaar

- VS.3133/05/2/6: Protein nutrition: protein turnover in muscle tissue of growing rats. 1984. F.K. Siebrits
- VS.3133/05/2/7: Protein nutrition in farm animals: estimation of protein digestibility in chickens. 1985. P.H. Henning
- VS.3133/05/3/4: Digestive physiology and metabolism aspects in the feeding of farm animals - glucose production. 1975. J.G. van der Walt
- VS.3133/05/3/12: Digestive physiology and metabolism aspects in the feeding of farm animals - bacterial growth, Na⁺ and K⁺. 1980. R.I. Mackie
- VS.3133/05/3/14: Digestive physiology and metabolism aspects in animal feeding - growth constants, cellulolytic bacteria. 1973. R.I. Mackie
- VS.3133/05/3/17: Digestive physiology and metabolism aspects in the feeding of farm animals: ammonia transport and its influence on nitrogen metabolism in rumen bacteria. 1984. Johanna J. Therion
- VS.3133/05/3/18: Digestive physiology and metabolism aspects in the feeding of farm animals: regulation and control of proteases in pure cultures of rumen bacteria. 1984. E. Strydom
- VS.3133/05/3/19: Animals: influence of lactation and nutrition on the metabolism of lipogenic precursors. 1985. J.G. van der Walt
- VS.3133/05/3/20: Digestive physiology and metabolism aspects in animal feeding: partitioning of ruminal acetate and propionate between lipogenesis and gluconeogenesis, respectively in sheep. 1986. M.J. Linington
- VS.3133/05/3/21: Digestive physiology and metabolism aspects in animal feeding - peptide transport and utilisation by rumen bacteria. 1986. K. Westlake
- VS.3133/05/3/23: Digestive physiology and metabolism aspects in animal feeding - development of an *in vitro* method for evaluating protein digestibility. 1987. P.H. Henning
- VS.3133/05/3/24: Digestive physiology and metabolism aspects in animal feeding: ruminal microbial yield during *in vitro* incubation of grain mixtures. 1987. P.H. Henning
- VS.3133/05/3/25: Digestive physiology and metabolism aspects in animal feeding: evaluation of acetate clearance rate as an index of growth rate and lipogenesis in lambs fed roughage-based diets. 1987. P.B. Cronje
- VS.3133/05/4/4: Crop residues of by-products for animal nutrition - pigs and poultry. 1982. J. Viljoen
- VS.3133/05/6/5: Dietary components in feeds for animal feeding: whole maize grain. 1984. J.P. Campher
- VS.3133/05/6/6: Dietary components in feeds for animal feeding: combinations of energy sources. 1985. P.H. Henning
- VS.3133/05/6/7: Dietary components in feeds for animal feeding: water-reconstituted grain sorghum in fattening diets for beef steers. 1985. N. Slabbert
- VS.3133/05/6/8: Dietary components in feeds for animal feeding: the influence of grain softness on the utilisation of whole maize by beef steers. 1985. N. Slabbert
- VS.3133/05/6/9: Dietary components in feeds for animal feeding: ammoniated grain sorghum in fattening diets for beef steers. 1987. N. Slabbert

• *Genetics/Genetika*

- VS.3133/06/1/1: Genetic defects in farm animals - hipoplasies cattle. 1979. E.H.H. Meyer
- VS.3133/06/1/2: Genetic aspects of polymorphism in farm animals - milk polymorphism. 1977. E.H.H. Meyer
- VS.3133/06/1/3: Genetic aspects of haemoglobins in farm animals - cattle. 1977. E.H.H. Meyer
- VS.3133/06/1/4: Genetic aspects of blood typing in farm animals. 1969. S.J. du Plessis.
- VS.3133/06/1/5: Genetic production models for farm animals - milk production. 1977. C.Z. Roux
- VS.3133/06/1/6: Laboratory animals in genetic studies: efficiency of feed utilisation. 1978. M.M. Scholtz
- VS.3133/06/1/7: Breeding of laboratory animals in genetic studies. 1977. E.H.H. Meyer

- VS.3133/06/1/9:** Genetic aspects of karyotyping in farm animals. 1978. N.D. Nel
- VS.3133/06/1/10:** Laboratory animals in genetic studies: milk production estimation techniques - rats. 1982. M.M. Scholtz
- VS.3133/06/1/11:** The genetic maintenance of small animal populations and the effect of in-breeding on production characteristics. 1982. J.C. Greeff
- VS.3133/06/1/12:** Genetic studies on farm animals: preparation of monospecific anti-sera against lymphocyte antigens for investigation into the immune system of cattle. 1985. J. Bester
- VS.3133/06/1/13:** Genetic studies on farm animals: development of biochemical methodology for antigen characterisation with regard to genetic aspects of the immune system. 1985. M.C. Field

● *Upgrading/Veredeling*

- VS.3133/07/1/1:** Upgrading studies on indigenous animals - maintenance, evaluation and improvement of indigenous Sanga cattle. 1982. M.M. Scholtz
- VS.3133/07/1/2:** Upgrading studies on indigenous animals - cytogenetic studies on Nguni cattle. 1982. N.D. Nel
- VS.3133/07/1/3:** Upgrading of animals: the evaluation of highly fertile sheep - breeds and strains in crosses. 1982. J.C. Greeff
- VS.3133/07/1/4:** Upgrading studies on animals: evaluation of the influence of the importation of germ plasm on studd-cattle breeding. 1985. H.E. Theron
- VS.3133/07/1/5:** Animals: genetic aspects of protein and enzyme polymorphism in sheep and goats. 1985. M.C. Reid
- VS.3133/07/1/6:** Upgrading of animals: production models and statistical methods for the breeding of farm animals. 1986. C.Z. Roux
- VS.3133/07/2/1:** Biotechnical research for the upgrading of farm animals: the production of monozygotic twins using embryo splitting. 1986. N.D. Nel

Biotechnology/Animal science/Biotegnologie/Veekunde

BIOTECHNOLOGY/BIOTEGNOLOGIE

● *Upgrading/Veredeling*

- VS.3141/07/1/1:** Biotechnological research for the upgrading of farm animals: the production of monozygotic twins using embryo splitting. 1986. N.D. Nel
- VS.3141/07/1/2:** Biotechnological research for the upgrading of farm animals: genome mapping by restriction fragment length polymorphisms in livestock. 1987. N.D. Nel

VETERINARY RESEARCH/VEEARTSENYKUNDIGE NAVORSING

Pathological investigations/Patologiese ondersoeke

PATHOLOGICAL INVESTIGATIONS/PATOLOGIESE ONDERSOEKE

● *Pathology/Patologie*

- OP.3211/19/1/1:** Diagnostic pathological investigations into mortalities of animals through macro- and microscopical techniques. 1981. J.A.W. Coetzer
- OP.3211/19/1/2:** Diagnostic investigations into mortalities through electron microscopical techniques. 1981. L. Prozesky

- OP.3211/19/2/8: Pathological investigations: toxicology, clinical pathology and pathology of *Cestrum laevigatum* poisoning in sheep and cattle. 1985. J.J. van der Lugt
- OP.3211/19/2/9: The documentation of the toxicological chemical, chemical-pathological and pathological aspects of *Crotalaria sparioides* poisoning in rabbits and cattle. 1986. J.J. van der Lugt
- OP.3211/19/2/10: Pathological investigations: electron microscopic studies of platelets from lambs infected with Rift Valley fever virus and Wesselsbron disease virus. 1986. J.A.W. Coetzer
- OP.3211/19/2/11: Toxicological, pathophysiological and pathological aspects of *Galenia africana* poisoning in sheep. 1986. J.J. van der Lugt

Food hygiene/Voedselhigiëne

ANIMAL FOODS/DIERLIKE VOEDSELS

• Pathology/Patologie

- OP.3221/19/1/1: Animal foods: diagnosis of mastitis as a herd problem. 1981. W.H. Giesecke
- OP.3221/19/1/2: Animal foods: microscopical investigation of the teat tip and canal at different stages of udder development. 1982. I.M. Clayden
- OP.3221/19/1/3: Animal foods: lacteal levels of glucose and frequencies of subclinical mastitis and other udder conditions. 1981. W.H. Giesecke
- OP.3221/19/1/5: Animal foods: the effect of teat dipping on subclinical udder conditions in dairy cows milked by a machine. 1982. W.H. Giesecke
- OP.3221/19/1/7: Animal foods: normal bacterial flora on bovine udders as affected by age, breed and season. 1979. Anette M. Durand
- OP.3221/19/1/9: Animal foods: interlaboratory standardisation of somatic cell counts in cows' milk in the RSA. 1983. W.H. Giesecke
- OP.3221/19/1/10: Animal foods: the development of the methodology for an investigation of primary prostaglandins and thromboxanes in the normal and pathological udder secretion. 1985. Z.E. Kowalski
- OP.3221/19/1/11: Animal foods: a methodological investigation of the lipoxxygenase products of arachidonic acid in normal and pathological udder secretions and tissue homogenates. 1985. Z.E. Kowalski
- OP.3221/19/3/1: Animal foods: potentially pathogenic micro-elements in animal feeds. 1981. Anette M. Durand
- OP.3221/19/3/4: The use of bacterial adenosinetriphosphate (ATP) analysis for the determination of the bacteriological quality of animal feeds. 1985. S.M. Payze

• Technology/Tegnologie

- OP.3221/52/2/1: Animal foods: differentiation of the species origin of different meat types. 1983. W.H. Giesecke

Toxicological investigations/Toksikologiese ondersoeke

TOXIC SUBSTANCES/TOKSIESE STOWWE

• Toxicology/Toksikologie

- OP.3231/18/1/1: Diagnostics of poisoning of animals by toxic substances. 1981. T.S. Kellerman

- OP.3231/18/2/1: The role of fungi, plants and toxic substances in the aetiology and pathogenesis of photosensitivity. 1971. T.S. Kellerman
- OP.3231/18/2/4: Evaluation of the efficacy of medical and industrial activated charcoals in the prophylaxis and treatment of plant poisonings and mycotoxicoses. 1984. T.S. Kellerman
- OP.3231/18/2/5: Salinomycin poisoning in horses. 1985. P.W. Nel
- OP.3231/18/2/6: Toxic substances: pathogenesis and early diagnosis of gousiekte. 1987. N. Fourie

Internal parasite investigations/Interne-parasietondersoeke

HELMINTHS/HELMINTE

• Taxonomy/Taksonomie

- OP.3241/01/1/1: Identification of helminths and investigation of definite host ranges. 1983. E.L. Visser
- OP.3241/01/1/2: The taxonomy and incidence of helminths of the Cape hyrax (*Procavia capensis*). 1983. E.L. Visser

• Pests/Plae

- OP.3241/20/1/1: Helminths: diagnosis of unknown internal parasite phenomena. 1981. J.A. van Wyk
- OP.3241/20/2/1: Helminths: immunology and serology of cysticercosis of cattle and pigs. 1970. E.L. Visser
- OP.3241/20/2/5: Helminths: epidemiology of tapeworms of ruminants. 1982. E.L. Visser
- OP.3241/20/2/6: Helminths: incidence and treatment of *Stilesia globipunctata* infestation in South Africa. 1983. E.L. Visser
- OP.3241/20/3/1: Helminths: reinfestation of cattle with bilharzia. 1969. J.A. van Wyk
- OP.3241/20/3/2: Helminths: influence of temperature on the development of the larval stages of *Fasciola* spp. 1979. R.M.R. Alves
- OP.3241/20/3/3: Helminths: development of *Fasciola* spp. of cattle and sheep in various definitive hosts. 1978. R.M.R. Alves
- OP.3241/20/3/4: Helminths: pathological physiology of *Schistosoma matthei* infestation of sheep and cattle. 1969. J.A. van Wyk
- OP.3241/20/3/5: Helminths: epidemiology of paramphistomiasis. 1981. J.A. van Wyk

• Chemical control/Chemiese beheer

- OP.3241/21/1/1: Chemical control of helminths with special reference to resistance. 1982. J.A. van Wyk

• Technology/Tegnologie

- OP.3241/52/1/1: Helminths: long-term storage of pure strains of helminths. 1973. J.A. van Wyk
- OP.3241/52/1/2: Recovery of helminths and/or their ova from animals. 1976. J.A. van Wyk
- OP.3241/52/1/3: Helminths: *ante-mortem* determination of worm loads in animals. 1985. J.A. van Wyk
- OP.3241/52/1/4: Helminths: an investigation of various egg counting methods and the development of quicker *post-mortem* techniques for the determination of internal parasite loads. 1987. F.J. de Villiers

Reproduction investigations/Reproduksie-ondersoeke

INFERTILITY/ONVRUGBAARHEID

• Pathology/Patologie

- CP.3251/19/1/1: Diagnostics of infertility and abortion in animals. 1973. B. Gummow
OP.3251/19/1/2: Serodiagnostics of infertility, abortion and other diseases. 1981. C.C. Williamson
OP.3251/19/2/2: Infertility: immunity to trichomoniasis in cattle. 1981. S. Herr
OP.3251/19/2/3: Infertility: ulcerative dermatosis in sheep. 1981. C.J.V. Trichard
OP.3251/19/2/5: Infertility: bacterial infections of the genitalia of sheep. 1981. B.C. Jansen

Entomological investigations/Entomologiese ondersoeke

EXTERNAL PARASITES/EKSTERNE PARASIEDE

• Entomology/Entomologie

- OP.3261/14/1/1: External parasites: identification and systematics of insects of veterinary importance. 1981. E.M. Nevill

• Acarology/Akarologie

- OP.3261/15/1/1: External parasites: identification and systematics of ticks and mites of veterinary importance. 1981. J.B. Walker
OP.3261/15/1/2: External parasites: systematics of the genus *Rhipicephalus*. 1973. J.B. Walker
OP.3261/15/1/3: External parasites: identification and systematics of mites of veterinary importance. 1986. L.C. Jordaan

• Pathology/Patologie

- OP.3261/19/1/1: External parasites: *Cowdria ruminantium* in *Amblyomma hebraeum*. 1977. J.D. Bezuidenhout
OP.3261/19/1/2: External parasites: multiplication of arboviruses in *Culicoides* spp. 1973. E.M. Nevill
OP.3261/19/1/3: External parasites: aetiology of sweating sickness. 1971. P.T. Oberem
OP.3261/19/1/4: External parasites: the congenital resistance of new-born calves against heartwater. 1987. J.L. du Plessis
OP.3261/19/1/8: External parasites: a biochemical study of the tissues of *Rhipicephalus evertsi*, *Hyalomma* spp., *Exodes rubicundus*, *Boophilus* spp. and *Ornithodoros savignyei* with special reference to their toxins. 1984. J.D. Bezuidenhout
OP.3261/19/1/9: External parasites: determination of the tick load that will ensure enzootic stability with regard to heartwater. 1984. J.L. du Plessis
OP.3261/19/1/10: External parasites: the epidemiology of Karoo paralysis. 1985. J.D. Bezuidenhout
OP.3261/19/1/11: External parasites: the *in vitro* cultivation of *Cowdria ruminantium*. 1985. J.D. Bezuidenhout
OP.3261/19/1/12: External parasites: the role of complement, conglutinin and immune-conglutinin in the pathogenesis of heartwater. 1985. J.L. du Plessis
OP.3261/19/1/13: External parasites: the use of the Welgevonden strain of *Cowdria ruminantium* for heartwater research. 1986. J.L. du Plessis
OP.3261/19/1/14: External parasites: the congenital resistance of new-born calves against heartwater. 1987. J.L. du Plessis

• *Pests/Plae*

- OP.3261/20/1/3: External parasites: biology and control of *Simulium* spp. in South Africa. 1968. L.C. Jordaan
- OP.3261/20/1/4: External parasites: resistance of ticks to acaricides. 1976. A.M. Spickett
- OP.3261/20/1/5: External parasites: tick resistance in indigenous and European cattle breeds. 1982. A.M. Spickett
- OP.3261/20/1/6: External parasites: the effects of host immunity of Brahman and Hereford cattle breeds on the dynamics of tick populations in a mixed sourveld environment. 1984. A.M. Spickett
- OP.3261/20/1/7: External parasites: hosts of *Amblyomma hebraeum* and their importance in the epidemiology of heartwater. 1985. J.D. Bezuidenhout

Virus investigations/Virusondersoeke

VIRUSES/VIRUSSE

• *Pathology/Patologie*

- OP.3271/19/1/1: Diagnostics of virus diseases of animals. 1981. B.J.H. Barnard
- OP.3271/19/2/3: Growth attenuation of African horse sickness viruses in tissue culture. 1968. B.J. Erasmus
- OP.3271/19/2/5: Modification of bluetongue virus in tissue culture. 1970. B.J. Erasmus
- OP.3271/19/2/6: Characterisation of newer orbiviruses. 1973. B.J. Erasmus
- OP.3271/19/2/7: Flavivirus infection of sheep and cattle. 1981. B.J.H. Barnard
- OP.3271/19/2/8: Survey of bluetongue and other viruses in *Culicoides* spp. 1979. B.J. Erasmus
- OP.3271/19/2/9: Viruses: the epidemiology of bovine malignant catarrh. 1983. B.J.H. Barnard
- OP.3271/19/2/10: Viruses: pathogenicity and tick transmission of Crimean Congo haemorrhagic fever in cattle and sheep. 1984. B.J. Erasmus

Highly contagious diseases/Hoogsaansteeklike siektes

HIGHLY CONTAGIOUS VIRUSES/HOOGSAANSTEEKLIKE VIRUSSE

• *Pathology/Patologie*

- OP.3281/19/1/1: Diagnostics of highly contagious virus diseases of animals. 1980. G.R. Thomson
- OP.3281/19/1/2: Highly contagious viruses: the development of ELISA techniques for the detection of foot-and-mouth disease (FMD) and swine vesicular disease (VSD) viruses and antibodies directed against them. 1985. J.J. Esterhuyzen
- OP.3281/19/2/1: Highly contagious viruses: epidemiology of African swine fever in free-living hosts. 1978. G.R. Thomson
- OP.3281/19/2/3: Highly contagious viruses: the role of wild cloven-hoofed animals in the epidemiology of foot-and-mouth disease. 1981. G.R. Thomson
- OP.3281/19/2/4: Highly contagious viruses: assessment of foot-and-mouth disease vaccines. 1983. C.D. Meredith
- OP.3281/19/2/5: Highly contagious viruses: investigation of the excretion of SAT types of foot-and-mouth disease (FMD) virus from experimentally infected cattle. 1984. M.D. Gainaru

- OP.3281/19/2/6: Gamma irradiation for the inactivation of highly contagious viruses in animal products. 1986. G.R. Thomson

Poultry and fish diseases/Pluimvee- en vissiektes

POULTRY/PLUIMVEE

• Pathology/Patologie

- OP.3291/19/1/1: Diagnostics of disease conditions of poultry. 1981. F.W. Huchzermeyer
OP.3291/19/2/2: Altitude disease ascites of broilers. 1985. F.W. Huchzermeyer
OP.3291/19/2/3: Turkey malaria. 1985. F.W. Huchzermeyer
OP.3291/19/2/4: Studies on the pathogenicity of rough and non-typable strains of *Escherichia coli* isolated from poultry. 1987. M.A. Kloryga

FISH/VIS

• Pathology/Patologie

- OP.3292/19/1/1: Diagnostics of disease conditions of fish. 1981. R.R. Bragg

Bacterial investigations/Bakteriese ondersoeke

BACTERIA/BAKTERIEë

• Pathology/Patologie

- OP.32101/19/1/1: Diagnostics of bacterial diseases of animals. 1981. Marijke M. Henton
OP.32101/19/2/4: Bacteria: improvement of *E. coli* vaccines. 1982. P. Oberem
OP.32101/19/2/7: Investigation of various culture media for optimal growth of *Camphylobacter fetus* for vaccine production. 1984. M.L. van der Walt
OP.32101/19/2/8: A study of the occurrence of plasmids and lysogenic phages and its correlation with toxin production in *Clostridium perfringens* type D. 1986. G. Groenewald

Protozoal investigations/Protosoa-ondersoeke

PROTOZOA/PROTOSOA

• Pathology/Patologie

- OP.32111/19/1/1: Diagnostics of protozoal and rickettsial diseases of animals. 1981. D.T. de Waal
OP.32111/19/2/1: Protozoa: quality, safety and efficacy of Onderstepoort vaccines against bovine babesiosis. 1981. D.T. de Waal
OP.32111/19/2/2: Protozoa: epidemiology of *Besnoitia besnoitii* infection in cattle. 1981. D.T. de Waal
OP.32111/19/2/3: Protozoa: identity, distribution and transmission of *Theileria* spp. in South Africa. 1977. W.H. Stoltz
OP.32111/19/2/6: Protozoa: *in vitro* cultivation of *Babesia* spp. with special reference to *Babesia bovis*. 1984. F.T. Potgieter
OP.32111/19/2/7: Protozoa: a study of babesiosis in horses. 1984. D.T. de Waal

- OP.32/11/19/3/1: Protozoa: the quality, safety and efficacy of Onderstepoort anaplasmosis vaccines. 1981. F.T. Potgieter
- OP.32/11/19/3/2: Protozoa: transmission of *Anaplasma marginale* by ticks and biting insects. 1977. F.T. Potgieter

Molecular biological investigations/Molekulêre biologiese ondersoeke

MACROMOLECULES/MAKROMOLEKULE

• Virology/Virologie

- OP.32/21/12/1/3: Macromolecules: serological studies of jaagsiekte retrovirus. 1982. M.S. Myer
- OP.32/21/12/1/4: Macromolecules: cloning of jaagsiekte virus through genetic manipulation. 1982. E.S. Posnett
- OP.32/21/12/1/6: Production of monoclonal antibodies against jaagsiekte retrovirus antigens. 1985. D.F. York
- OP.32/21/12/1/7: Macromolecules: the distribution and role of lentiviruses in sheep in South Africa. 1986. D.W. Verwoerd

• Protozoology/Protoosoölogie

- OP.32/21/13/1/1: Macromolecules: the construction and partial characterisation of genomic libraries of *Babesia* and *Anaplasma* DNA. 1985. R.E. Ambrosio
- OP.32/21/13/1/2: Macromolecules: isolation of DNA and the construction and partial characterisation of a genomic library of *Cowdria ruminantium*. 1987. R.E. Ambrosio
- OP.32/21/13/1/3: Macromolecules: the development of probes for the detection of *Anaplasma* in bovine blood. 1987. E.S. Visser
- OP.32/21/13/1/4: Macromolecules: the isolation and characterisation of the probes for the identification of *Babesia equi* and *Babesia caballi* in horses. 1987. E.S. Posnett

Biochemical investigations/Biochemiese ondersoeke

BIOCHEMICAL INVESTIGATIONS/BIOCHEMIESE ONDERSOEKE

• Virology/Virologie

- OP.32/31/12/1/7: The use of vaccinia virus expression vector for the neutralising antigen, protein P2 of bluetongue virus. 1987. Alberdina A. van Dijk
- OP.32/31/12/1/8: Biochemical investigations: an investigation of the composition and function of the virus specific tubules which are found in orbivirus infected cells. 1987. Alberdina A. van Dijk
- OP.32/31/12/1/9: Biochemical characterisation of equine encephalosis virus and the development of diagnostic genomic probes for the virus. 1987. G.J. Viljoen
- OP.32/31/12/1/10: The development and use of cloned genome segments as probes for the identification of horsesickness virus. 1987. C.W. Vroon
- OP.32/31/12/1/11: Preparation and characterisation of monoclonal antibodies to African horsesickness virus. 1987. W. van Wyngaardt
- OP.32/31/12/1/12: Biochemical investigation of the structure and function of a phosphorylated non-structural protein of bluetongue virus. 1986. S.J. Hall
- OP.32/31/12/1/13: An investigation of the composition and genetic variation of the group-specific antigen of bluetongue virus. 1987. M. Cloete

- OP.32/31/12/1/14: Identification of the nucleotide sequence coding for the neutralisation specific epitope or epitopes of bluetongue virus. 1987. N.T. van der Walt

Chemical pathology and poison chemistry/Chemiese patologie en gifstofchemie

POISONS/GIFSTOWWE

• Toxicology/Toksikologie

- OP.32/41/18/1/1: Poisons of and poisoning by cardiac glycosides from plants of the family Crassulaceae. 1981. L.A.P. Anderson
- OP.32/41/18/1/2: Poisons of and poisoning caused by *Cynanchum* species. 1981. G.L. Erasmus
- OP.32/41/18/1/3: Poisons of and poisoning caused by *Sarcostemma viminale*. 1984. L.A.P. Anderson
- OP.32/41/18/1/4: Poisons of and poisoning caused by *Ornithogalum thyrsoides*. 1983. J. de V. du Toit
- OP.32/41/18/1/5: An investigation of *Albizia tanganyicensis* poisoning. 1986. L.A.P. Anderson
- OP.32/41/18/1/6: An investigation of *Lasiospermum bipinnatum* poisoning. 1986. L.A.P. Anderson
- OP.32/41/18/2/1: Poisons of and poisoning caused by tremorgenic mycotoxins of *Aspergillus clavatus*. 1975. L.A.P. Anderson

AGRICULTURAL RESOURCE UTILISATION LANDBOUHULPBRONBENUTTING

RESOURCE RESEARCH/HULPBRONNAVORSING

Primary resources/Primêre hulpbronne

SOIL/GROND

• *Soil science/Grondkunde*

- GB.5111/32/1/3: Soil fertility - a basis according to which soils can be grouped. 1975. A.J. van der Merwe
- GB.5111/32/2/1: The isolation, identification, quantitative determination and chemical reactions of growth stimulating and inhibiting organic compounds in soil and crop residues of summer and small grains. 1980. P. de L. R. Swartz
- GB.5111/32/3/1: The distribution and properties of liming materials and waste products with reference to suitability for amelioration of RSA soils. 1979. H.C.H. Hahne
- GB.5111/32/3/2: Silicon-phosphorus-sesquioxide relationships with a view to amelioration of acid soils with silicate. 1979. H.C.H. Hahne
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• *Meteorology/Weerkunde*

- GB.5113/33/1/1: Acquisition and processing of climatic data of the RSA. 1978. A.V. Kotze
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Surveys and demarcation/Opnames en afbakening

SOIL SURVEYS/GRONDOPNAMES

• *Soil science/Grondkunde*

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• *Remote sensing application/Afstandwaarnemingstoepassing*

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BOERDERYGEBIEDE

• *Ecology/Ekologie*

- K.5134/27/1/2: RHFA: final ordination of land types suitable for veld grazing into reasonably homogeneous farming areas in the Karoo Region. 1986. M. Vorster
- K.5134/27/2/1: RHFA: classification of irrigation areas in the Extension Ward Cradock. 1980. P.S. van Heerden
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LAND USE/GRONDGEBRUIK

• *Situation analysis/Situasiebepaling*

- N.5135/35/1/1: Present land use survey of Natal (Agriquest). 1979. J.B.M. Smith

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- V.5135/36/1/1: Land use: collection of animal production norms and associated practices in the Vryburg magisterial district. 1988. P.J. Odendaal
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OTHER SURVEYS/ANDER OPNAMES

• *Situation analysis/Situasiebepaling*

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- HK.5136/36/1/1: Other surveys: agricultural development plan for Rehoboth Gebiet. 1982. C.H. de Klerk
- K.5136/36/1/1: Other surveys: determination of stocking rate benchmarks in the Eastern Mixed Karoo of the Karoo Region. 1987. W. v.D. Botha
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- K.5136/36/1/4: Other surveys: determination of stocking rate benchmarks in the Great Karoo of the Karoo Region. 1987. W. v.D. Botha
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- K.5136/36/1/7: Other surveys: determination of stocking rate benchmarks in the western Winter Rainfall Mountain Karoo of the Karoo Region. 1987. W. v.D. Botha
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• *Extension science/Voorligtingkunde*

- HK.5136/40/1/1: Other surveys: an investigation into the efficiency of study groups in Transvaal. 1984. C.H. de Waal

Irrigation development/Besproeiingsontwikkeling

IRRIGATION PLANNING/BESPROEIINGSBEPLANNING

• *Crop science/Gewaskunde*

- T.5141/30/1/1: Irrigation planning: the influence of row spacing and plant density on the yield of maize under trickle irrigation. 1986. W.F. van Wyk

• *Situation analysis/Situasiebepaling*

- D.5141/35/1/1: The collection of data relating to existing irrigation practices in the Fish River irrigation area. 1987. R.F.M. Childs

• *Evaluation/Evaluasie*

- GB.5141/37/1/1: Evaluation of areas for irrigation development and farm layout on State Schemes. 1979. J. Myburgh
- GB.5141/37/1/2: Evaluation of existing irrigation schemes. 1982. J. Myburgh

RESOURCE UTILISATION RESEARCH (CROPS) HULPBRONBENUTTINGSNAVORSING (GEWASSE)

Field crops/Landgewasse

SUMMER GRAIN/SOMERGRAAN

• *Nutrition/Voeding*

- D.5211/05/1/1: Summer grain: NPK nutrition of maize at Dohne. 1978. R.S. Marr
- D.5211/05/1/2: Summer grain: NPK nutrition of maize at Sternberg. 1978. R.S. Marr
- D.5211/05/1/3: Summer grain: NP nutrition of maize at Sternberg. 1980. R.S. Marr
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- D.5211/05/1/5: Summer grain: nutrition of maize-phosphorus carriers and lime in the Tsitsikamma area. 1988. R.S. Marr

• *Pests/Plae*

- T.5211/20/1/1: Summer grain: survey of fungus-growing termites on agronomic crops. 1977. H.H. Gouse

• *Crop science/Gewaskunde*

- D.5211/30/1/1: Summer grain: maize planting dates at Dairyland, Bathurst. 1979. R.S. Marr
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- D.5211/30/1/4: Summer grain: cultivar evaluation at Dohne. 1987. R.S. Marr
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- H.5211/30/1/1: Summer grain: verification of production techniques and yield norms for grain sorghum on an Arcadia soil form in the Highveld Region. 1985. G.H. Koen
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- H.5211/30/1/3: Summer grain: the evaluation of production techniques and yield norms for grain sorghum on a Rensburg soil form in RHFA 6018 in the Highveld Region. 1986. G.H. Koen
- H.5211/30/1/4: The effect of row width and plant population on the growth and yield of grain sorghum on a Bainsvlei soil form in RHFA 6018 in the Highveld Region. 1988. G.H. Koen

- H.5211/30/2/1:** Summer grain: verification of production techniques and yield norms for maize on a Bainsvlei soil form in the Highveld. 1985. H.S. Lombard
- H.5211/30/2/2:** Summer grain: production techniques and yield norms for maize in the Highveld Region. 1986. P.J. Laubscher
- H.5211/30/2/3:** Summer grain: soil tillage practices for maize on a Hutton and Avalon soil form in RHFA 6006 in the Highveld Region. 1986. P.J. Laubscher
- T.5211/30/1/1:** Maize: the influence of between and within row spacing on soil water utilisation and yield under dryland conditions. 1988. I.D. Lamprecht
- V.5211/30/1/1:** Summer grain: irrigation and nitrogen fertilisation studies with maize at Upington. 1985. A. van Schalkwyk
- V.5211/30/1/2:** Summer grain: irrigation and nitrogen fertilisation studies with maize at Vaalharts. 1985. A. van Schalkwyk
- V.5211/30/1/3:** Summer grain: maize production under different irrigation systems at Vaalharts. 1986. A. van Schalkwyk
- V.5211/30/2/1:** Summer grain: crop residue management and seedbed preparation practices for dryland maize in a monoculture system at Sandvet. 1986. C. Engelbrecht

● *Potential studies/Potensiaalstudies*

- D.5211/36/2/1:** Summer grain: production and economic norms of no-till maize on a commercial scale at Dohne. 1983. J.A.G. Nel

● *Modelling/Modellering*

- H.5211/42/1/1:** The development of a simulation type model to predict production of the more important summer grains in the Highveld Region. 1985. P.J. van Rooyen

SMALL GRAIN/KLEINGRAAN

● *Physiology/Fisiologie*

- W.5212/03/1/1:** Small grain: the biology of ridgetop brome (*Bromus diandrus*) in the Winter Rainfall Region. 1985. H.M. Ferreira

● *Nutrition/Voeding*

- W.5212/05/1/1:** Small grain: the influence of time and amount of application of nitrogen fertiliser on wheat production in the Winter Rainfall Region. 1980. J.W. Loubser
- W.5212/05/1/2:** Small grain: the influence of different nitrogen fertilisation rates on the nitrogen content of the plant and grain as well as a study of the resulting malting quality of barley. 1986. F.P. Goosen

● *Pathology/Patologie*

- V.5212/19/1/1:** Small grain: the effect of cultivars, soil/water regime and *Fusarium inoculum* levels at planting time on dryland wheat production at Glen. 1985. O. Los
- V.5212/19/2/1:** Small grain: investigations on the occurrence of root disease organisms of wheat in an experimental plot under irrigation at Vaalharts. 1985. O. Los
- W.5212/19/1/1:** Small grain: factors influencing the occurrence and intensity of *Fusarium* root disease in wheat in the Winter Rainfall Region. 1988. L. Mills
- W.5212/19/1/2:** Small grain: the influence of tillage and crop rotation on the incidence of take-all (*Gaeumannomyces graminis* var. *tritici*) in wheat in the Winter Rainfall Region. 1987. F.C.J. Bester

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- *Pests/Plae*
- V.5212/20/1/1: Small grain: investigation on the occurrence of the brown wheat mite under dryland conditions at Glen. 1984. J. de Jager
- V.5212/20/1/2: Small grain: investigations on the effect of the brown wheat mite on grain yield, as well as possible control measures under dryland conditions at Glen. 1984. J. de Jager
- W.5212/20/1/1: Small grain: a study of the identity, occurrence, biology and ecology of aphids on small grain in the Winter Rainfall Region. 1975. S.S. Walters
- W.5212/20/1/2: The pest status of aphids associated with small grain in the Winter Rainfall Region. 1978. S.S. Walters
- W.5212/20/1/3: Small grain: bio-ecological study of *Sitobion avenae* on small grain in the winter rain cropping area of the Winter Rainfall Region. 1984. J.M. Laubscher
- W.5212/20/2/1: Small grain: biology and control of the dune mole-rat (*Bathyrgeus suillus*). 1986. J. de V. Burger
- W.5212/20/3/1: Small grain: factors influencing the distribution and abundance of the dune snail, *Theba pisana* and related pest snails in the Winter Rainfall Region. 1986. J. de V. Burger
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- W.5212/21/1/1: Chemical weed control of different broad leaf and grass weeds in small grain production in the Winter Rainfall Region. 1974. J.W. Loubser
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Ruminants/Herkouers

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• *Physiology/Fisiologie*

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RESOURCE UTILISATION RESEARCH (PASTURE) HULPBRONBENUTTINGSNAVORSING (WEIDING)

Pasture/Weiding

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- PE.5622/48/5/3: Management techniques: farm management studies with mail-in records as data source in the Highveld Region. 1964. P.F. du Plessis
- PE.5622/48/6/1: Management techniques: the use of income and cost budgets for effective planning of livestock and crop enterprises in the Winter Rainfall Region. 1973. C.H. Ferrandi
- PE.5622/48/7/1: Management techniques: the use of income and cost budgets for effective planning of livestock and crop enterprises in the Natal Region. 1973. E.N.C. Whitehead
- PE.5622/48/7/2: Management techniques: the use of income and cost budgets for effective planning of livestock and crop enterprises in the Free State Region. 1973. A. de K. Marais
- PE.5622/48/7/3: Management techniques: preparation and updating of machinery cost standards. 1980. E.N.C. Whitehead
- PE.5622/48/8/1: Management techniques: the use of income and cost budgets for effective planning of livestock and crop enterprises in the Karoo Region. 1973. S.S. Hansen
- PE.5622/48/8/2: Management techniques: the use of income and cost budgets for effective planning of livestock and crop enterprises in the Eastern Cape Region. 1973. C.J. Potgieter
- PE.5622/48/9/1: Management techniques: the use of income and cost budgets for effective planning of livestock and crop enterprises in the Transvaal Region. 1973. D.C. du Toit
- PE.5622/48/9/2: Management techniques: the use of income and cost budgets for effective planning of livestock and crop enterprises in the summer rain cropping area of the Highveld Region. 1973. P.F. du Plessis

ENTERPRISE RELATIONSHIPS/BEDRYFSVERHOUDINGS

• *Production economics/Produksie-ekonomie*

- PE.5623/48/1/5: Enterprise relationship: cost benefit analysis for the supply of irrigation water out of the Theewaterskloof Dam to the Eersteriviervallei. 1986. J.M. van Zyl
- PE.5623/48/1/6: The optimum choice of agricultural enterprises in identified regions in the Swartland. 1988. R.J. Nowers

- PE.5623/48/2/2: Enterprise relationship: the introduction of long-term pasture crops in sheep production systems in the central grassveld of the Free State Region. 1982. A. de K. Marais
- PE.5623/48/2/5: Assessment of the profitability of irrigated pastures for livestock farming in the highland sourveld regions of Natal. 1984. A. de K. Marais
- PE.5623/48/2/6: Some economic aspects of fertiliser usage in maize production in Natal. 1986. C.G. Berry
- PE.5623/48/2/7: Enterprise relationship: a long-term economic evaluation of sheep production systems at different stocking rates on climax grasslands in the central Free State. 1986. A. Odendaal
- PE.5623/48/2/8: Enterprise relationship: an examination of the economic and financial causes of non-optimal utilisation of natural pastures in the magisterial district of Gordonia. 1988. J.J. Kamfer
- PE.5623/48/3/1: Enterprise relationship: the economic evaluation of the utilisation of fodder crops with Merino sheep in the Fish River Valley. 1982. S.S. Hansen
- PE.5623/48/3/2: Enterprise relationship: the economic evaluation of development studies of components of dry-grass bushveld grazing in the Eastern Cape. 1976. C.J. Potgieter
- PE.5623/48/3/3: Enterprise relationship: the economic evaluation of the potential pastures in respect of small stock in the eastern coastal areas of the Eastern Cape. 1976. C.J. Potgieter
- PE.5623/48/3/4: Enterprise relationship: the development and evaluation of a profitable livestock farming system for the Valley Bushveld areas in good condition in the Eastern Cape Region. 1983. C.J. Potgieter
- PE.5623/48/3/5: Enterprise relationship: the development and evaluation of a profitable livestock farming system for the Valley Bushveld in deteriorated condition of the Eastern Cape Region. 1983. C.J. Potgieter
- PE.5623/48/3/6: Enterprise relationship: the development, management and evaluation of adapted livestock farming system Campagna in the high rainfall sourveld areas of the Eastern Cape. 1983. C.J. Potgieter
- PE.5623/48/4/1: Enterprise relationship: wintering of woolled sheep and other livestock in the northern Drakensberg grazing region. 1982. H.A. Minnaar
- PE.5623/48/4/3: Enterprise relationship: the influence of different feeding strategies on the economic efficiency of beef cattle in the summer rain cropping areas. 1983. J.J. de Bruyn
- PE.5623/48/4/5: An economic analysis of dairy enterprises and their financial roles in the farming structure of mixed farming in the summer rain cropping area. 1984. P.J. Cornelius
- PE.5623/48/4/7: Enterprise relationship: strategy for production continuation and renewal of citrus and subtropical orchards in the bushveld area. 1984. D.C. du Toit
- PE.5623/48/4/9: Enterprise relationship: the economic evaluation of the RHFA concept with respect to the minimising of risk and the determination of land values. 1986. J.J. de Bruyn
- PE.5623/48/4/10: Enterprise relationship: the influence of different feeding strategies on the economic efficiency of small stock farming in the summer rain cropping areas. 1986. P.F. du Plessis
- PE.5623/48/4/11: The economic justification of the introduction/expansion of livestock enterprises in stead of crop production on marginal soils. 1988. F.J. de Jager

SOIL CONSERVATION RESEARCH/GRONDBEWARINGSNAVORSING

Soil conservation/Grondbewaring

EROSION/EROSIE

• *Situation analysis/Situasiebepaling*

- V.5711/35/1/1: Erosion: investigation of the functional efficiency of subsidised waterways in the middle Free State subregion. 1985. S.J. van Reenen

• *Conservation studies/Bewaringstudies*

- D.5711/38/1/1: Erosion: the determination of soil losses associated with various tillage practices on various soil series established to pineapples in the East London district. 1982. B. Denyer
- D.5711/38/1/2: Erosion: the determination of soil losses associated with various tillage practices and land use on soil series at Alexandria. 1983. B. Denyer
- D.5711/38/1/3: The determination of soil losses associated with various tillage practices and land use on various soil series in Humansdorp Extension Ward. 1986. B. Denyer
- D.5711/38/1/4: Erosion: the correlation of soil loss figures obtained from natural run-off plots and rainfall simulator trials on pineapple ridges. 1985. B. Denyer
- D.5711/38/2/2: Erosion: the effect of various small structures in eroded watercourses in the high rainfall sourveld. 1985. E. Marx
- D.5711/38/2/3: Erosion: the effect of small structures in eroded watercourses in the bushveld areas. 1984. G.M. Bicknell
- D.5711/38/2/4: The influence of small conservation structures and re-established plant cover in the eroded low lying areas in the Henderson semi-palatable bushveld. 1987. P.C. Griffiths
- D.5711/38/4/1: To determine the maximum safe length and fall in ridges as well as spacing of contours on various pineapple land lay-outs associated with various tillage practices and soil series in order to combat erosion. 1985. B. Denyer
- N.5711/38/1/1: Erosion studies using natural run-off plots. 1985. W.B. Russell
- N.5711/38/1/2: Studies using a rainfall simulator and natural run-off plots to quantify soil losses from veld. 1982. R.P. Simms
- N.5711/38/1/3: Erosion and run-off studies on pineapple lands in Zululand. 1987. W.B. Russell
- V.5711/38/1/1: Erosion: investigation of adapted grass covers for waterways in RHFA 4053. 1985. P.J. Knoester
- V.5711/38/2/1: Erosion: water run-off control planning of the Immigrant area in the Petrusburg Extension Ward. 1985. F.J. Smit
- V.5711/38/2/2: Erosion: water run-off control planning of subcatchment area 3 of the Korannaberg catchment area in Excelsior district in the Brandfort Extension Ward. 1985. S.J. van Reenen
- V.5711/38/2/3: Erosion: water run-off control planning of the Rondas area in the Brandfort Extension Ward. 1986. C.S. van Niekerk
- V.5711/38/2/4: Erosion: water run-off control planning of the Spioenheuvel area in the Boshof district in the Kimberley Extension Ward. 1987. J.H. Mulder
- V.5711/38/3/1: Erosion: investigation of the functional efficiency of different types of small conservation structures in eroded areas in dongas and gullies in the Edenburg Extension Ward. 1985. S. Brink

- V.5711/38/3/2: Erosion: investigation of the functional efficiency of different types of small conservation structures in dongas and gullies in the Postmasburg Extension Ward. 1985. J. Weyers

• *Engineering/Ingenieurskunde*

- LI.5711/51/1/1: Engineering aspects of soil erosion: aspects of gully erosion. 1983. P.J. Strumpher
LI.5711/51/1/2: Engineering aspects of soil erosion: aspects regarding soil losses. 1983. P. McPhee

DRAINAGE/DREINERING

• *Agrohydrology/Agrohidrologie*

- V.5712/34/1/1: The planning and implementation of drainage systems on waterlogged and salinised irrigation lands in the Vaalharts irrigation area. 1985. J.H. Mulder
V.5712/34/1/2: The planning and implementation of drainage systems on waterlogged and salinised irrigation lands in the Douglas Extension Ward. 1985. J.H. Mulder

RESOURCE CONSERVATION/HULPBRONBEWARING

Planning of areas/Beplanning van gebiede

FARM PLANNING/PLAASBEPLANNING

• *Agrohydrology/Agrohidrologie*

- N.5831/34/1/1: Farm planning: run-off control planning in the Howick Extension Ward. 1979. M.G. Price
N.5831/34/1/2: Farm planning: run-off control planning in the Greytown Extension Ward. 1979. R.C. Richardson
N.5831/34/1/3: Farm planning: run-off control planning in the Ixopo Extension Ward. 1979. A.D. Simpson
N.5831/34/1/4: Farm planning: run-off control planning in the Pongola Extension Ward. 1979. R.J. Dicks
N.5831/34/1/5: Farm planning: run-off control planning in the Kokstad Extension Ward. 1979. D.B. Austin
N.5831/34/1/6: Farm planning: run-off control planning in the Richmond Extension Ward. 1979. E.M.F. McAllister
N.5831/34/1/7: Farm planning: run-off control planning in the Newcastle Extension Ward. 1979. M.P. Wentzel
N.5831/34/1/8: Farm planning: run-off control planning in the Vryheid Extension Ward. 1979. R.J. Dicks
N.5831/34/1/9: Farm planning: run-off control planning in the Estcourt Extension Ward. 1979. S.K. Armour
N.5831/34/1/10: Farm planning: run-off control planning in the Dundee Extension Ward. 1979. P.P. Kloppers
N.5831/34/1/11: Farm planning: run-off control planning in the Pietermaritzburg Extension Ward. 1979. P.J.D. Nicholson
N.5831/34/1/12: Farm planning: run-off control planning in the Ladysmith Extension Ward. 1979. K.W. Watkinson

- T.5831/34/1/2: Farm planning: run-off control of the north-eastern Springbok Flats area. 1980. J. Bellingham
- T.5831/34/1/3: Farm planning: run-off control in the south-eastern area of the Transvaal Region. 1976. M.M. Struthers
- T.5831/34/1/4: Farm planning: run-off control in the middle Transvaal area of the Transvaal Region. 1979. K.P. de Beer
- T.5831/34/1/5: Farm planning: run-off control in the Annysspruit area of the south-eastern Transvaal area. 1975. J.C. Nel
- T.5831/34/1/6: Farm planning: run-off control in the Klein-Komati area of the south-eastern Transvaal. 1975. J.C. Mouton
- T.5831/34/1/11: Farm planning: the design of a water run-off control system for the Strydom block area - Lowveld, Komatiepoort. 1975. M.V. Wattrus
- T.5831/34/1/12: Farm planning: run-off control in the Sabie Valley area - the design of a water run-off control system in the Sabie Valley and White River. 1975. M.V. Wattrus
- T.5831/34/1/13: Farm planning: run-off control in the Western Transvaal area (Syferbult) of the Transvaal Region. 1985. J.T. Nel
- T.5831/34/2/1: Farm planning: run-off control in the Badplaaskom area of the south-eastern area of the Transvaal Region. 1975. H.P. den Dulk
- T.5831/34/2/2: Farm planning: run-off control in the Western Transvaal (Bokfontein) area of the Transvaal Region. 1986. C.J. Meiring
- T.5831/34/2/3: Run-off control in the Western Transvaal area (Koedoeshoop West) of the Transvaal Region. 1986. G.P. Engelbrecht

• *Management/ Bestuur*

- D.5831/41/1/1: Planning of farms within the Alexandria magisterial district to promote the efficient conservation of natural resources. 1984. A.E.O. Botha
- D.5831/41/1/2: Planning of farms with regard to veld utilisation and resource conservation within the Elliot Extension Ward to promote the efficient utilisation and conservation of natural resources. 1985. E. Marx
- D.5831/41/1/3: Farm planning within the Barkly East Extension Ward to promote efficient utilisation and conservation of natural resources. 1985. J.S.J. Jordaan
- D.5831/41/1/4: Farm planning of farms within the Adelaide Extension Ward to promote efficient utilisation and conservation of natural resources. 1985. G.M. Bicknell
- D.5831/41/1/5: Planning of farms within the Bathurst magisterial district to promote the efficient utilisation and conservation of natural resources. 1985. B.I. Hill
- D.5831/41/1/6: Planning of farms within the Tarkastad magisterial district to promote the efficient utilisation and conservation of agricultural resources. 1983. W.J.M. Els
- D.5831/41/1/7: Planning of farms in the Komga magisterial district to promote the efficient utilisation and conservation of the natural resources. 1984. C.J. Bradfield
- D.5831/41/1/8: Planning of farms in the Stutterheim Extension Ward to promote the efficient utilisation and conservation of the natural resources. 1984. P.C. Griffiths
- D.5831/41/1/9: Planning of farms within the Sterkstroom magisterial district to promote the efficient utilisation and conservation of the natural resources. 1983. J.H. Fourie
- D.5831/41/1/10: Planning of farms within the Albany magisterial district to promote efficient utilisation and conservation of natural resources. 1986. W.J. Penny
- D.5831/41/1/11: Planning of farms with regard to veld utilisation and resource conservation within the Humansdorp Extension Ward to promote the efficient utilisation and conservation of natural resources. 1985. J.P. van Zyl
- D.5831/41/1/12: Planning of farms within the Molteno magisterial district (Dordrecht Extension Ward) to promote efficient utilisation and conservation of the natural resources. 1985. J.C. van der Walt

- D.5831/41/1/13: Planning of farms within the Uitenhage and Kirkwood magisterial districts to promote the efficient utilisation and conservation of the natural resources. 1985. C.S. van R. Müller
- D.5831/41/1/14: Planning of farms within the Queenstown magisterial district to promote the efficient utilisation and conservation of the natural resources. 1983. W.J.M. Els
- D.5831/41/1/15: Planning of farms in the Port Elizabeth magisterial district of the eastern seaboard area. 1986. R.P. Laing
- D.5831/41/1/16: Planning of farms within the Aliwal North Extension Ward to promote efficient utilisation and conservation of the natural resources. 1985. D.T. Bezuidenhout
- D.5831/41/2/1: Run-off control planning of farms in the sub-catchment area No. 10900104 in the Humansdorp Extension Ward. 1984. J.P. van Zyl
- D.5831/41/2/2: Run-off control planning of farms in the Zuney Valley, sub-catchment area No. 14200200. 1984. A.E.O. Botha
- D.5831/41/2/3: Farm planning: area run-off control planning in catchment areas No. 041308, 041309 and 041312 within the Barkly East Extension Ward. 1985. J.S.J. Jordaan
- D.5831/41/2/4: Farm planning: area run-off control planning in sub-catchment No. 17500400 in the Elliot Extension Ward. 1985. E. Marx
- D.5831/41/2/5: Run-off control planning of farms in the Baviaans River catchment area - drainage region No. 1560 - Bedford magisterial district. 1985. G.M. Bicknell
- D.5831/41/2/6: Area run-off control planning of farms in the Elands River Valley sub-catchments No. 12100100 and 11700300. 1985. C.S. van R. Müller
- D.5831/41/2/7: Farm planning: stabilising of eroded watercourses in upper Heuningklip River - sub-catchment area 1730/02/04. 1983. J.E. Aspinall
- D.5831/41/2/8: Farm planning: run-off control planning in a portion of the sub-catchment area No. 04130500 (Bossielaagte) situated in the Lady Grey magisterial district. 1985. D.T. Bezuidenhout
- D.5831/41/2/9: Water run-off control planning of farms in the area demarcated as Upper-Coerney, sub-catchment No. 13401501 in the Paterson area. 1985. R.P. Laing
- D.5831/41/2/11: Area run-off control planning of farms in the Buyskloof Valley, sub-catchment No. 14200100, in the eastern seaboard area. 1986. A.E.O. Botha
- D.5831/41/2/12: Farm planning: maintenance and improvement of existing run-off control plans on cultivated lands in the catchment areas No. 041308, 041309 and 041312 within the Barkly East Extension Ward. 1985. J.S.J. Jordaan
- D.5831/41/2/13: Farm planning: run-off control planning in the sub-catchment area 15430101 (Vrolikskraal) situated in the Molteno magisterial district. 1985. J.C. van der Walt
- D.5831/41/2/14: Farm planning: water run-off control - improvement and maintenance of existing contour systems in the Elands River catchment area. 1986. I. du P. Barlow
- D.5831/41/2/15: Farm planning: stabilising of eroded watercourses in Bamboeshoek, sub-catchment area No. 17300201. 1984. J.H. Fourie
- D.5831/41/2/16: Area run-off control planning of farms in the sourveld area in the Humansdorp Extension Ward of the Karoo and arid areas. 1986. E.C. Kieck
- D.5831/41/2/17: Area run-off control planning of farms in the Upper Krom River area in the Humansdorp Extension Ward of the eastern seaboard area. 1986. E.C. Kieck
- D.5831/41/2/18: Farm planning: area run-off control planning of irrigation lands in the Hankey magisterial district. 1986. R.P. Laing
- D.5831/41/2/19: Water run-off control planning of all pineapple farms in the East London Extension Ward. 1985. I.D. Scholtz
- D.5831/41/2/20: Farm planning: area run-off control planning of irrigation in the proposed Kabeljou irrigation area in the Humansdorp magisterial district. 1987. E.C. Kieck

- D.5831/41/2/21: Farm planning: area run-off control planning of lands in the Blue River Valley. 1988. C.J. Bradfield
- D.5831/41/2/22: Farm planning: water run-off control - determining the most suitable grass(es) to be used in waterways and watercourses in the Algoa subregion. 1988. I. du P. Barlow

ENTREPRENEUR DEVELOPMENT ONDERNEMERSONTWIKKELING

EXTENSION SCIENCE INVESTIGATIONS VOORLIGTINGKUNDIGE ONDERSOEKE

Resources and technology/Hulpbronne en tegnologie

MANAGEMENT FACTORS/BESTUURSAKTORE

- *Persuasion/Oorreding*

- T.6114/39/1/5: Management factors: the persuasion of farmers to optimal resource utilisation in the Koedoesrand area of northern Transvaal in the Transvaal Region. 1976. S.W. Burger

MAN/MENS

- *Situation analysis/Situasiebepaling*

- H.6115/35/1/1: Factors that influence the under-achievement of first-year students at Potchefstroom College of Agriculture. 1983. L.I. de Waal

- *Extension science/Voorligtingkunde*

- H.6115/40/2/1: Man: study group participation to agricultural development in the Lichtenburg subregion. 1985. M.M. Grobbelaar
- N.6115/40/1/1: Human potential in relation to optimum land use of farmers in the Underberg Extension Ward. 1974. D.M. Rix

RUN-OFF CONTROL/AFLOOPBEHEER

- *Agrohydrology/Agrohidrologie*

- T.6118/34/1/6: Run-off control in the Klein Komati area of the south-eastern Transvaal. 1975. J.C. Mouton
- T.6118/34/1/10: Run-off control: the design of a water run-off control system in the Bokpoort target area in Potgietersrus. 1975. J. Bellingham
- T.6118/34/1/11: Run-off control: the design of a water run-off control system for the Strydom block area - Lowveld, Komatipoort. 1975. M.V. Watrus
- T.6118/34/1/12: Run-off control in the Sabie Valley area - the design of a water run-off control system in the Sabie Valley, Witrivier. 1975. M.V. Watrus
- T.6118/34/2/1: Run-off control in the Badplaaskom area of the south-eastern Transvaal area of the Transvaal Region. 1975. J.C. Mouton

COMMUNICATION/KOMMUNIKASIE

- *Extension science/Voorligtingkunde*

- N.6119/40/1/1: The use of agricultural literature in communicating information to farmers in the Natal Region. 1982. Marion A. Abbott
- W.6119/40/1/1: Communication: an extension science investigation into the effectiveness of the table grape block competition in the Hex River Valley. 1985. G.G. van der Merwe

PROGRAMMED EXTENSION/GEPROGRAMMEERDE VOORLICHTING

Resource utilisation/Hulpbronbenutting

STOCK AND GAME FARMING/VEE- EN WILDBOERDERY

• Evaluation/Evaluasie

- D.6211/37/1/1: Stock and game farming: to demonstrate the utilisation and control of tree and shrub species in the humid grass/bush communities of the Bathurst Extension Ward. 1987. P.G. King
- D.6211/37/1/2: Stock and game farming: to assess vegetation change in the Alexandria ward due to the aerial application of a herbicide to *Acacia karroo*. 1986. A.E. du Plessis

• Persuasion/Oorreding

- D.6211/39/1/1: Stock and game farming: the persuasion of farmers to promote optimal pasture utilisation and animal production in the Queenstown Extension Ward. 1984. L.P.J. Swart
- D.6211/39/1/2: Stock and game farming: the persuasion of farmers to promote optimal pasture utilisation and animal production in the Bedford magisterial district. 1986. J.B. Marais
- D.6211/39/1/3: Stock and game farming: the persuasion of farmers to promote optimal pasture utilisation and animal production in the Albany magisterial district. 1986. J.L. Clacey
- D.6211/39/1/4: Stock and game farming: to train farmers in the Adelaide and Bedford magisterial districts to subjectively assess veld condition in the False Thornveld. 1987. J.B. Marais
- D.6211/39/1/5: Stock and game farming: the persuasion of farmers to promote optimal pasture utilisation and animal production in the Alexandria Extension Ward. 1986. A.E. du Plessis
- D.6211/39/1/6: Stock and game farming: training of collaborators and extension officers in the Eastern Cape Region to achieve optimum milk production. 1986. P.J. Olivier
- D.6211/39/1/7: Stock and game farming: promotion of adopted stock farming in the Valley Bushveld of the Uitenhage Extension Ward. 1984. L.O. Grobler
- D.6211/39/1/8: Stock and game farming: persuasion of farmers in the Port Elizabeth Extension Ward to achieve optimum pasture and animal production. 1987. J.B.C. Kilfoil
- D.6211/39/1/9: Stock and game farming: training of farmer collaborators and extension staff in the Eastern Cape Region to promote optimum small stock production. 1987. J.C. Scheltema
- D.6211/39/1/10: Stock and game farming: the persuasion of farmers in the Thomas River conservation district to control and eradicate silver and black wattle. 1986. A.M. Grenfell
- D.6211/39/1/11: Stock and game farming: the persuasion of farmers to promote optimal pasture utilisation and animal production in the Stutterheim Extension Ward. 1986. A.M. Grenfell
- D.6211/39/1/12: Stock and game farming: the determination of veld grazing utilisation practices and farmer's knowledge and perceptions regarding these veld management practices in the King Williams Town and Komga districts. 1985. W.E. Ristow
- D.6211/39/1/13: Stock and game farming: the persuasion of farmers to promote optimal pasture utilisation and animal production in the King William's Town and Komga districts. 1986. W.E. Ristow
- D.6211/39/1/14: Stock and game farming: the persuasion of farmers to promote optimal pasture utilisation and animal production in the Humansdorp Extension Ward - high potential agricultural area. 1987. F.J. Weitz

- D.6211/39/1/15: Stock and game farming: the persuasion of farmers to promote optimal pasture utilisation and animal production in the Humansdorp Extension Ward - sourveld. 1987. F.J. Weitz
- D.6211/39/1/16: Stock and game farming: the persuasion of farmers to achieve optimum grazing utilisation and animal production in the Dordrecht Extension Ward. 1986. D.W. Schoeman
- D.6211/39/1/17: Stock and game farming: the persuasion of farmers to promote optimal veld utilisation and animal production in the Elliot Extension Ward. 1987. G.R. Morgan
- D.6211/39/1/18: Stock and game farming: the persuasion of farmers to promote optimal maize production in the Elliot Extension Ward. 1987. G.R. Morgan
- D.6211/39/1/19: Stock and game farming: the persuasion of farmers to achieve optimal pasture utilisation and animal production in the Elliot Extension Ward. 1987. G.R. Morgan
- D.6211/39/1/20: Stock and game farming: the persuasion of farmers to achieve optimum pasture utilisation and animal production in the Aliwal North Extension Ward. 1986. O.V. Loest
- D.6211/39/2/1: Stock and game farming: promotion of adapted stock farming in the Valley Bushveld of the Uitenhage Extension Ward. 1984. L.O. Grobler
- K.6211/39/1/1: Stock and game farming: persuasion of farmers to apply the group camp approach of veld management in the Extension Ward of Graaff-Reinet. 1985. J.G. Theron
- K.6211/39/1/2: Stock and game farming: persuasion of farmers to apply the group camp approach of veld management in the Cradock Extension Ward. 1985. P.S. van Heerden
- K.6211/39/1/3: Stock and game farming: persuasion of farmers to practise the group camp approach of veld management in the Burgersdorp Extension Ward. 1985. J.H. Spoelstra
- K.6211/39/1/4: Stock and game farming: persuasion of farmers to practise the group camp approach of veld management in the Colesberg Extension Ward. 1985. M. van Niekerk
- K.6211/39/1/5: Stock and game farming: persuasion of farmers to practise the group camp approach of veld management in the De Aar Extension Ward. 1985. N. Wilson
- K.6211/39/1/6: Stock and game farming: persuasion of farmers to practise the group camp approach of veld management in the Middelburg Extension Ward. 1985. J.D. Blom
- K.6211/39/1/7: Stock and game farming: persuasion of farmers to practise the group camp approach of veld management in the Calvinia Extension Ward. 1985. N. Nortje
- K.6211/39/1/8: Stock and game farming: persuasion of farmers to practise the group camp approach of veld management in the Carnarvon Extension Ward. 1985. G.Z.J. Barnard
- K.6211/39/1/9: Stock and game farming: persuasion of farmers to practise the group camp approach of veld management in the Kenhardt Extension Ward. 1985. J.J. Zandberg
- K.6211/39/1/10: Stock and game farming: persuasion of farmers to practise the group camp approach of veld management in the Prieska Extension Ward. 1985. D.J. Roux
- K.6211/39/1/11: Stock and game farming: persuasion of farmers to practise the group camp approach of veld management, Beaufort West Extension Ward. 1986. A.J. Wiid
- K.6211/39/1/12: Stock and game farming: persuasion of farmers to practise the group camp approach of veld management, Fraserburg Extension Ward. 1986. I.J. van der Merwe
- K.6211/39/2/1: Stock and game farming: persuasion of farmers to introduce drought fodder crops in the farming systems in the Graaff-Reinet Extension Ward. 1984. J.G. Theron
- K.6211/39/2/2: Stock and game farming: persuasion of farmers to establish drought fodder crops in the Colesberg Extension Ward. 1985. M. van Niekerk
- K.6211/39/2/3: Stock and game farming: persuasion of farmers to establish drought fodder crops in the De Aar Extension Ward. 1985. W.H. van Staden
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- V.6211/39/1/1: Stock and game farming: the persuasion of stock farmers in the Molopo Extension Ward to contain bush encroachment. 1985. M.J. van den Heever
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- N.6211/41/1/1: Stock and game farming: analysis of beef production management systems in the Underberg Extension Ward. 1985. C.M. Allan
- N.6211/41/1/2: Stock and game farming: the analysis of stock and game management systems on veld in the Pongola Extension Ward. 1986. D.M. Gammon

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- N.6211/42/1/1: Stock and game farming: development of a beef feeding simulator programme. 1975. B.P. Louw
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CROP FARMING/SAAIBOERDERY

● *Chemical control/Chemiese beheer*

- N.6212/21/1/1: Crop farming: insect pests of maize and their control. 1986. R.A. Bell

● *Persuasion/Oorreding*

- K.6212/39/2/1: Crop farming: persuasion of farmers to practise optimal irrigation management and techniques in the Cradock Extension Ward. 1984. P.S. van Heerden
- K.6212/39/2/2: Crop farming: persuasion of farmers to practise optimal irrigation management and techniques in the Somerset East Extension Ward. 1984. P.S. van Heerden
- N.6212/39/1/1: The promotion of improved crop farming practices in the Winterton conservation area. 1976. S.D. le Roux
- V.6212/39/1/1: Crop farming: the persuasion of irrigation farmers in the Rietrivier Irrigation Scheme to apply irrigation scheduling with the aid of the PUTU irrigation model. 1988. P.M. le Roux
- W.6212/39/1/3: Crop farming: persuasion of farmers in the George Extension Ward to incorporate lupins as a crop in their farming systems. 1985. W.G.J. Voigt
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- W.6212/39/2/2: Crop farming: persuasion of farmers in the Moorreesburg area of jurisdiction to raise the profitability of farming by the use of physical financial management information. 1985. W. Burger
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MIXED FARMING/GEMENGDE BOERDERY

● *Persuasion/Oorreding*

- D.6213/39/1/1: Mixed farming: to persuade crop farmers in the Alexandria Extension Ward to adopt optimal crop production systems. 1986. A.E. du Plessis
- D.6213/39/1/2: Mixed farming: to persuade farmers in the Alexandria ward to implement the water run-off control plans drawn up for their farms. 1987. A.E. du Plessis
- D.6213/39/1/3: Mixed farming: the training of extension personnel in the east coast and central subregions with regard to economic principles and concepts and their practical application. 1987. J.F. Els
- D.6213/39/1/4: Mixed farming: to persuade landowners to effectively protect their lands which are situated above the Gamtoos State Water Scheme and for which run-off control programmes were served. 1987. H.J. Smith

- D.6213/39/1/5: Mixed farming: optimal resource development of the irrigation area in the Hankey magisterial district. 1987. H.J. Els
- H.6213/39/1/1: Persuasion of farmers with mixed farming enterprises in the Bethlehem Extension Ward in order to promote optimal land utilisation. 1981. J.H. de Klerk
- H.6213/39/1/2: Persuasion of farmers with mixed farming enterprises in the Harrismith Extension Ward in order to promote optimal land utilisation. 1983. J.T. van Rooyen
- H.6213/39/1/3: Persuasion of farmers with mixed farming enterprises in the Kroonstad Extension Ward in order to promote optimal land utilisation. 1981. P.J. van Wyk
- H.6213/39/1/4: Persuasion of farmers with mixed farming enterprises in the Bothaville Extension Ward in order to promote optimal land utilisation. 1979. J.I. de V. Burger
- H.6213/39/1/5: Persuasion of farmers with mixed farming enterprises in the Parys Extension Ward in order to promote optimal land utilisation. 1981. A.G.H. Kotze
- H.6213/39/1/6: Persuasion of farmers with mixed farming enterprises in the Klerksdorp Extension Ward in order to promote optimal land utilisation. 1981. C.F. van Eeden
- H.6213/39/1/7: Persuasion of farmers with mixed farming enterprises in the Lichtenburg subregion in order to promote optimal land utilisation. 1982. M.M. Grobbelaar
- H.6213/39/1/8: Persuasion of farmers with mixed farming enterprises in the Heidelberg subregion in order to promote optimal land utilisation. 1978. C.C.A. Breed
- H.6213/39/1/9: Persuasion of farmers with mixed farming enterprises in the Wolmaransstad Extension Ward in order to promote optimal land utilisation. 1986. A.J. Loretz
- H.6213/39/1/10: Persuasion of farmers with mixed farming enterprises in the Potchefstroom Extension Ward in order to promote optimal land utilisation. 1986. J.J. Steyn
- H.6213/39/1/11: Persuasion of farmers with mixed farming enterprises in the Vrede Extension Ward in order to promote optimal land utilisation. 1987. M.J. Marais
- H.6213/39/1/12: Persuasion of farmers with mixed farming enterprises in the Standerton Extension Ward in order to promote optimal land utilisation. 1987. J.A. Rafferty
- H.6213/39/1/13: Persuasion of farmers with mixed farming enterprises in the Frankfort Extension Ward in order to promote optimal land utilisation. 1987. P.J. Smith
- H.6213/39/1/14: Persuasion of farmers with mixed farming enterprises in the Schweizer Reneke Extension Ward in order to promote optimal land utilisation. 1987. A.M. Potgieter
- N.6213/39/1/1: The promotion of optimum production based on resource planning in the Pietermaritzburg Extension Ward. 1986. G. McGrath
- T.6213/39/1/1: Mixed farming: the persuasion of farmers to practise optimal resource utilisation in the high rainfall sourveld area of Belfast. 1985. A. van Deventer
- T.6213/39/2/1: Mixed farming: situation analysis of the irrigation practices in the Groblersdal Extension Ward. 1986. M.G. du Toit
- T.6213/39/3/1: Mixed farming: situation analysis of the peach industry in the Silverton Extension Ward. 1986. J.B. Stevens
- T.6213/39/3/2: Mixed farming: determination of a benchmark of the peach industry by means of case studies in the Silverton Extension Ward. 1986. J.B. Stevens
- T.6213/39/3/3: Mixed farming: training of peach farmers in the implementation of adopted practices. 1987. J.B. Stevens
- V.6213/39/1/1: Mixed farming: the persuasion of stock farmers in the Mafeking Extension Ward to contain bush encroachment. 1985. W. Goldblatt
- V.6213/39/1/2: Mixed farming: the persuasion of stock farmers in the Mafeking Extension Ward to adopt improved grazing and stock farming practices. 1985. W. Goldblatt
- V.6213/39/1/3: Mixed farming: the persuasion of stock farmers in the Mafeking Extension Ward to keep farming records and to adopt financial management practices. 1985. W. Goldblatt
- V.6213/39/1/4: Mixed farming: the persuasion of demonstrator farmers to determine the grazing potential of grazing capacity zones in the Mafeking Extension Ward. 1985. W. Goldblatt

V.6213/39/1/5: Mixed farming: the persuasion of demonstrator farmers to develop economic methods for the eradication of sandgeelhout invader plants. 1985. W. Goldblatt

• *Norm studies/Normstudies*

D.6213/50/1/1: Mixed farming: collection and processing of pasture and animal production data for use in dairy production. 1986. P.J. Olivier

D.6213/50/1/2: Mixed farming: collection and processing of pasture and animal production data for use in small stock production. 1986. J.C. Scheltema

FRUIT FARMING/VRUGTEBOERDERY

• *Situation analysis/Situasiebepaling*

N.6214/35/1/1: Situation analysis: bananas in the Port Shepstone Extension Ward. 1983. E.H. Gevers

• *Persuasion/Oorreding*

T.6214/39/1/1: Fruit farming: the persuasion of guava farmers to optimal resource utilisation in the irrigation areas of the Lowveld. 1982. J.J. Kruger

T.6214/39/1/2: The persuasion of banana producers to optimal resource utilisation in the irrigation areas of the Transvaal Lowveld. 1983. C.C. Engelbrecht

W.6214/39/1/1: Fruit farming: persuasion of farmers in the Langkloof farming area to implement recommended soil-plant combinations, correct soil preparation and established techniques. 1985. W.S. van der Merwe

VEGETABLE FARMING/GROENTEBOERDERY

• *Persuasion/Oorreding*

W.6215/39/1/1: Vegetable farming: persuasion of onion farmers in the Caledon Extension Ward to implement improved farming techniques. 1985. C.L. van Rooyen

VITICULTURE/WINGERDBOERDERY

• *Persuasion/Oorreding*

V.6216/39/1/1: Viticulture: the persuasion of grape farmers in the Upington Extension Ward to apply pre-harvest bunch treatment. 1988. D.J. Malan

W.6216/39/1/1: Viticulture: persuasion of farmers in the Vredendal Extension Ward to apply correct techniques of winter pruning and manipulation of summer foilage. 1985. S. Lutz

W.6216/39/1/2: Viticulture: persuasion of farmers in the Vredendal Extension Ward to apply updated techniques of irrigation. 1986. P.B. van der Merwe

W.6216/39/2/1: Viticulture: persuasion of farmers in the Amalienstein/Van Zylsdamme farming area to implement optimal irrigation techniques. 1985. M.J. de W. Delpont

W.6216/39/3/1: Viticulture: persuasion of farmers in the Mamalienstein/Van Zylsdamme farming area to implement recommended soil-plant combinations, correct soil preparation and establishment techniques for perennial crops. 1985. M.J. de W. Delpont

W.6216/39/3/2: Viticulture: persuasion of farmers in the irrigation areas of Montagu Extension Ward to implement recommended soil-crop combinations, correct soil preparation and establishment techniques for perennial crops. 1985. W.J. Basson

W.6216/39/4/1: Viticulture: persuasion of farmers in the Wellington Extension Ward to implement scientifically founded establishment practices for perennial crops. 1985. W.J.K. Ferreira

AGRICULTURAL ENGINEERING SERVICES LANDBOU-INGENIEURSDIENSTE

Agricultural mechanisation/Landboumeganisasie

POWER SOURCES AND LABOUR/KRAGBRONNE EN ARBEID

- *Engineering/Ingenieurskunde*

- LI.6711/51/1/1: Evaluation of tractor characteristics - power take-off shaft and safety frames. 1982. J.J.P.C. Swanepoel
- LI.6711/51/1/2: Power sources and labour: performance of two-wheel, four-wheel and crawler track-driven tractors under a variety of conditions. 1981. R.W. Otterman

AGRICULTURAL IMPLEMENTS/LANDBOUWERKTOIE

- *Engineering/Ingenieurskunde*

- LI.6712/51/1/1: Engineering aspects of agricultural machinery. 1982. A.J. Heyns

Agricultural structures and facilities/Landboustrukture en -fasiliteite

CLIMATE-CONTROLLED STRUCTURES/KLIMAATBEHEERDE STRUKTURE

- *Engineering/Ingenieurskunde*

- LI.6722/51/1/1: Engineering aspects of climatic-controlled structures. 1982. P.J. Britz

STOCK HOUSING AND FACILITIES/VEEBEHUISING EN -FASILITEITE

- *Engineering/Ingenieurskunde*

- LI.6723/51/1/1: Engineering aspects of animal housing and facilities. 1982. P.A. Henning
- LI.6723/51/1/2: Engineering aspects of animal housing and related facilities in the Winter Rainfall Region. 1982. J.C. Venter

Irrigation and drainage engineering/Besproeiings- en dreineringsingenieurswese

IRRIGATION/BESPROEIING

- *Engineering/Ingenieurskunde*

- LI.6731/51/1/1: Engineering aspects of irrigation. 1982. F.B. Reinders

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- *Engineering/Ingenieurskunde*

- LI.6732/51/1/1: Engineering aspects of sub-surface drainage systems. 1982. F.J.C. Hugo

BOTANY/BOTANIE

BOTANY RESEARCH/BOTANIESE NAVORSING

Plant taxa/Planttaksons

FLORA

• *Taxonomy/Taksonomie*

- PL.7111/01/1/6: Flora of southern Africa: Liliaceae - Dracaenoideae and Asparagoideae. 1979. G.E. Gibbs Russell
- PL.7111/01/1/7: Flora of southern Africa: Ericaceae - minor genera. 1970. E.G.H. Oliver
- PL.7111/01/1/14: Flora of southern Africa: Bryophyta. 1976. J. van Rooy
- PL.7111/01/1/17: Flora of southern Africa: keys to southern African grasses. 1981. G.E. Gibbs Russell
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- PL.7111/01/1/19: Flora of southern Africa: Restionaceae. 1981. G.E. Gibbs Russell
- PL.7111/01/1/20: Flora of southern Africa: the tribe Desmodiae (Fabaceae - Papillonoideae). 1981. B.D. Schrire
- PL.7111/01/1/21: Flora of southern Africa: Orchidaceae. 1981. G.E. Gibbs Russell
- PL.7111/01/1/23: Flora of southern Africa: Salicaceae, Fabaceae, Urticaceae and Piperaceae. 1984. K.L. Immelman
- PL.7111/01/1/24: Flora of southern Africa: the tribe Tephrosieae (Fabaceae - Papillonoideae). 1985. B.D. Schrire
- PL.7111/01/1/26: Flora of southern Africa: Liliaceae - Aloineae - *Aloe*. 1985. H.F. Glen
- PL.7111/01/1/27: Flora of southern Africa: the tribe Indigoferae (Fabaceae-Papillonoideae). 1987. B.D. Schrire
- PL.7111/01/1/28: Flora of southern Africa: Lythraceae, Lecythidaceae and Rhizophoraceae. 1987. K.L. Immelman
- PL.7111/01/1/29: Flora of southern Africa: Portulacaceae. 1988. H.F. Glen
- PL.7111/01/1/30: Flora of southern Africa: Convolvulaceae. 1988. W.G. Welman
- PL.7111/01/2/1: Illustrated flora of the Pretoria region. 1973. O.A. Leistner
- PL.7111/01/2/2: Regional flora: Transvaal wild flowers (Vol. 2). 1984. G. Germishuizen
- PL.7111/01/2/3: Flora of Namaqualand. 1987. G.E. Gibbs Russell
- PL.7111/01/2/4: Flora of Transvaal. 1988. E. Retief
- PL.7111/01/3/1: Pretoria National Herbarium Computerised Information System (PRECIS) for the flora of southern Africa: Specimen Database. 1986. G.E. Gibbs Russell
- PL.7111/01/3/2: Pretoria National Herbarium Computerised Information System (PRECIS) for the flora of southern Africa: Taxon Database. 1986. G.E. Gibbs Russell
- PL.7111/01/3/3: Pretoria National Herbarium Computerised Information System (PRECIS) for the flora of southern Africa: Nomenclatural Database. 1986. G.E. Gibbs Russell

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• *Taxonomy/Taksonomie*

- PL.7112/01/1/1: Taxonomy of Angiospermae: the family Polygonaceae. 1979. T.H. Arnold

- PL.7112/01/1/3: Taxonomy of Angiospermae: the genus *Ficinia* (section Bracteosae). 1976. G. Germishuizen
- PL.7112/01/1/5: Taxonomy of Angiospermae: the genus *Justicia* in southern Africa. 1982. K.L. Immelman
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- PL.7112/01/1/7: Taxonomy of Angiospermae: the genus *Vigna* Savi in southern Africa. 1984. B.J. Pienaar
- PL.7112/01/1/8: Taxonomy of Angiospermae: the genus *Carex* L. in southern Africa. 1985. C. Reid
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**BIOMETRIC AND DATAMETRIC SERVICES
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